AD-A058 464 O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA JUSTIN--ETC F/G 13/2
NATIONAL DAM SAFETY PROGRAM. RECORDS POND DAM (DE00057), NANTIC--ETC(U)
JUN 78 J J WILLIAMS DACW61-78-C-0052

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LEVEL II

NANTICOKE RIVER BASIN

BROAD CREEK, SUSSEX COUNTY

DELAWARE

RECORDS POND DAM

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Approved for public release;
distribution unlimited

DE 00057

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

JUNE 1978

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER DE00057	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Phase I Inspection Report National Dam Safety Program Records Pond Dam(NJ00057) Sussex County Delaware		5. TYPE OF REPORT & PERIOD COVERED FINAL rept., 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) John J. Williams		8. CONTRACT OR GRANT NUMBER(s) DACW61-78-C-0052
9. PERFORMING ORGANIZATION NAME AND ADDRESS O'Brien & Gere Engineers Inc. Justin & Courtney Div. 1617 J.F.K. Blvd. Phila. Pa. 19103		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 82p.
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chesnut Streets Phila. Penna. 19106		12. REPORT DATE Jun 1978 13. NUMBER OF PAGES 77
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

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17. DISTRIBUTION STATEMENT *(of the*

National Dam Safety Program. Records Pond Dam (DE00057), Nanticoke River Basin, Broad Creek, Sussex County, Delaware, Phase 1 Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Dams- Del.
National Dam Safety Program Phase I
Records Pond Dam, Del.

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

28 JUL 1978

Honorable Pierre S. DuPont
Governor of Delaware
Dover, Delaware 19901

Dear Governor DuPont:

Inclosed is the Phase I Inspection Report for Records Pond Dam in Sussex County, Delaware which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given on the first two pages of the report.

Based on visual inspection, available records, calculations and past operational performance, Records Pond Dam is judged to be in fair condition. However, the spillway is considered to be seriously inadequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Hydrologic and hydraulic investigations and engineering studies should be initiated within three months of the date of approval of this report to determine corrective action required to increase the capacity of the spillway to pass at least ½ PMF. Construction of an improved spillway should commence in calendar year 1979. Due to the potential for overtopping of the dam, a detailed emergency operation, drawdown and warning system should be developed by the owner within the next two months.

b. Within one year from the date of approval of this report trees and brush should be removed from the embankments, slope erosion corrected and a suitable controlled vegetation established.

A copy of the report is being furnished to Mr. Austin P. Olney, Delaware Department of Natural Resources and Environmental Control, the designated State Office contact for this Program. Within five days of the date of this letter, a copy will also be sent to Congressman Thomas B. Evans. Under the provisions of the Freedom of Information

NAPEN-D
Honorable Pierre S. DuPont

Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely yours,

Harry V. Dutchyshyn

HARRY V. DUTCHYSHYN
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Cy Furn:
Mr. Austin P. Olney, Secretary
Department of Natural Resources and
Environmental Control

LEVEL II

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam: Records Pond Dam

State Located Delaware
County Located Sussex County
Stream Broad Creek
Date of Inspection May 24, 1978

ASSESSMENT OF GENERAL CONDITIONS

The Records Pond Dam consists of four sluiceways or culverts controlled by movable, hand operated timber gates flanked by an earth causeway or dam. This causeway is Willow Street and the sluiceway or culverts are referred to as the Willow Street Bridge. A complete inspection of the gates was not possible since approximately eight (8) inches of water was flowing over them at the time of the inspection.

Although the structure was completed in 1900, it appears to be in fairly good condition. Aggregate is exposed in the concrete along both wing walls but no serious cracking is apparent.

Hydraulics/Hydrologic analyses reveal that the embankments would be overtopped for all storms exceeding approximately six (6) per cent of Probable Maximum Flood (PMF) ; therefore, the sluiceways can be

considered "seriously inadequate" as cited in Engineering Technical Letter No. 1110-2, January 25, 1978. In order to satisfy criteria established by the Department of the Army, Office of the Chief of Engineer, remedial measures that should be considered include providing an additional waterway to pass at least ½PMF without overtopping the embankments.

O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY

John J. Williams

John J. Williams, P.E.
Vice President

Based on visual inspection, available records calculations and past operational performance, Records Pond Dam is judged to be in fair condition. However, the spillway is considered to be seriously inadequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Hydrologic and hydraulic investigations and engineering studies should be initiated within three months of the date of approval of this report to determine corrective action required to increase the capacity of the spillway to pass at least ½ PMF. Construction of an improved spillway should commence in calendar year 1979. Due to the potential for overtopping of the dam, a detailed emergency operation, drawdown and warning system should be developed by the owner within the next two months.

b. Within one year from the date of approval of this report trees and brush should be removed from the embankments, slope erosion corrected and a suitable controlled vegetation established.

APPROVED: Harry V. Dutchyshyn

HARRY V. DUTCHYSHYN
Colonel, Corps of Engineers
District Engineer

DATE: 28 July 1978

UPSTREAM FACE WITH GATES

FOUR CELL BOX CULVERT DOWNSTREAM VIEW

TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM RECORDS POND DAM ID# 00057

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority - This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract #DACW 61-78-C-0057 between O'Brien and Gere Engineers, Justin and Courtney Division and the United States Army Engineer, Philadelphia District.

b. Purpose of Inspection - The purpose of this inspection is to evaluate the structural and hydraulic conditions of the Records Pond Dam and to determine if the dam constitutes a hazard to human life or property.

1.2 PROJECT DESCRIPTION - (According to information provided by the State of Delaware, Division of Soil and Water Conservation as itemized in Section 2.1 below.)

a. Description of Dam and Appurtenances - The dam at Records Pond is principally a water level control structure consisting of a four (4) cell box culvert with movable, hand operated timber gates flanked by an earth causeway or dam. The causeway is actually Willow Street and the box culvert structure is locally referred to as the Willow Street Bridge. Each of the four cells provides a flow opening approximately 7.1 feet wide and 7.7 feet high. The timber gates move vertically by hand operated cranks to control the water elevation in Records Pond. Flow passes through the structure and into a downstream pool which serves as the confluence of Broad Creek and Rossakatum Branch. Residential properties line the left bank of this pool and industrial property lines the right bank. Just downstream of this pool, Broad Creek passes under another road bridge which allows for a very short rise in pool elevation.

A depression exists in the Willow Street causeway near its intersection with Cooper Street. This depression appears lower than the top of the dam and apparently acts as an additional spillway allowing high flood water to flow onto Fourth Street, then into Rossakatum Branch and back into Broad Creek.

b. Location - Records Pond is located on Broad Creek just east of Laurel, Delaware, a community with a 1970 population of 2,408. The drainage area is 73.1 square miles as obtained from State of Delaware, Division of Highways computations entitled "Hydrology Investigation and Hydraulic Computation for Records Pond - Sussex County", dated October 9, 1970. The drainage area is approximately 8 miles long and 9.5 miles wide and is situated in both Sussex County, Delaware and Wicomico County, Maryland.

c. Size Classification - The maximum height of the dam is approximately 11 feet and the reservoir volume to normal pool elevation is 270 acre feet. Therefore, the dam is in the small size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification - Significant development is present immediately downstream of this structure and serious flooding would result in damage to personal property and, possibly, loss of human life. Therefore, Records Pond Dam should be classified in the high hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership - The dam is owned by the State of Delaware Department of Natural Resources and Environmental Control.

f. Purpose of Dam - Information provided by the State of Delaware lists the purpose of Records Pond and Dam as recreation.

g. Design and Construction History - According to information provided by the U.S.Army Engineer District, Philadelphia the present structure was completed in 1900. It was originally a privately owned water level control structure and presently is owned by the State of Delaware. From the visual inspection, it appears that the original design provided for a spillway at the southwest corner of the reservoir near the intersection of Willow Street and Cooper Street. Although the gated structure at that location is inoperable, the elevation of Willow Street near that intersection appears low enough to allow for flow to pass over the roadway before overtopping the main 4 cell box culvert.

Improvements/Plans were recommended by Edward H. Richardson Associates, Inc. dated 1/9/74. These included construction of a semi-circular weir just upstream of the present structure as shown in the enclosed Figure #3. The recommended spillway would be constructed of PMA-22 steel sheet piles with a downstream face and energy dissipation basin constructed of 150 pound stone riprap. Implementation of these improvements also calls for the construction of a 150 feet long earth dike located in the southwest corner of the reservoir to allow for increased storage. This dike would be lined on its upstream face with grouted riprap. These improvements/plans have not been implemented.

h. Normal Operational Procedure - Records Pond and Records Pond Dam are operated by the Division of Fish and Wildlife, Delaware Department of Natural Resources and Environmental Control. Under normal conditions, the water surface elevation in the pool is approximately 8.9.

According to officials from the Division of Fish and Wildlife, Department of Natural Resources and Environmental Control, the gates are opened each time rainfall occurs. Even light rainfall requires opening of the gates since Records Pond rises rapidly. Employees of the Division of Fish and Wildlife are responsible for operating the gates and for maintaining them in an operable condition. There is no flood warning system in effect.

1.3 PERTINENT DATA (Provided by The State of Delaware, Division of Soil and Water Conservation.)

a. Drainage Area - The drainage area for the Records Pond Reservoir is 73.1 square miles as taken from the State of Delaware Report of October 1970.

b. Discharge At Damsite - The maximum discharge at the damsite is unknown since no records were made available. However, from computations referred to in 1.2.b above, the 50 year discharge is 2,840 cfs or 1,835 MGD. Normal pool discharge is 10.3 MGD.

c. Elevation (Feet above MSL)

Top of Gates - 8.6
Normal Pool - 8.9
Willow Street Birdge Underclearance - 9.16

d. Reservoir (Miles)

Length of Normal Pool 1. 27

e. Storage (Acre Feet)

Normal Pool - 270

f. Reservoir Surface (Acres)

Normal Pool - 90

g. Dam

Type - Earthfill Causeway
Length - Approximately 500 feet
Height - Approximately 10.5 feet
Top Width - Approximately 18 feet (Roadway width)

h. Diversion and Regulating Tunnel

None

i. Spillway

Type - Four cell, gated box culvert
Combined Width of Culverts - 28.5 feet
Crest Elevation - 8.6 (variable)
Gates - 4 concrete cells (7.12 ft. x 7.67 ft.) with separate, hand operated timber gates.
- Flow area with gates full open = 221.2 sq. ft.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The available data relative to this structure consists of the following:

a. Preliminary Survey, Willow Street Bridge, October 1970 (includes sketches of existing structure)
b. Hydrology Investigation and Hydraulic Computations for Records Pond - Sussex County; October 1970
c. Investigation Report for Records Pond; November 1970
d. Sheet 1 through 4 describing proposed improvements to Records Pond Dam; January 1974
e. Water-Table, Surface-Drainage, and Engineering Soils Map of the Laurel Area, Delaware.

2.2 CONSTRUCTION

No information was made available.

2.3 OPERATION

In the event of any rainfall or potential flooding, the hand operated gates are opened in an attempt to prevent flow over the roadway. The operation is the responsibility of the Division of Fish and Wildlife, Department of Natural Resources and Environmental Control.

2.4 EVALUATION

Data regarding design and construction of the dam was not made available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The visual inspection of Records Pond Dam was conducted on May 24, 1978. At the time of the inspection, approximately 8 inches of water was flowing over the tops of the timber gates.

b. Dam - Minor concrete cracking is apparent and the aggregate is exposed in both wingwalls and in the culvert structure itself. However, the structure appears stable. Trees and brush growth are apparent directly adjacent to the concrete structure along the downstream slopes. Some erosion was noted along the downstream slope of the causeway. This could be the result of surface runoff along Willow Street or previous overtopping.

c. Appurtenant Structures - There are no appurtenant structures.

d. Reservoir Area - The tree and brush lined reservoir banks are stable, gently rising and well defined.

e. Downstream Channel - A downstream pool exists which serves as the confluence between Broad Creek and Rossakatum Branch. This pool is lined with residences on its left bank and industrial property on its right bank.

Just downstream of this pool is a roadway bridge. (See Photograph A-4) The bottom of the bridge girders were only a few feet above water surface elevation during inspection. This structure may act as a control in the event of flooding.

3.2 EVALUATION

The dam and 4 cell box culvert appear to be structurally sound. However, downstream flooding is probable since even light rainfall causes a considerable rise in Records Pond as reported by officials from the Department of Natural Resources and Environmental Control.

SECTION 4 - OPERATIONAL PROCEDURES

Operational procedures are discussed in Section 1.2h.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - The Probable Maximum Flood (PMF) was determined from Probable Maximum Precipitation and Standard Reduction Factors for this geographic location and basin size. The peak discharge of the PMF is approximately 84,000 cfs. The peak discharge of ½PMF is approximately 42,500 cfs. The U.S. Army Corps of Engineers computer program HEC-1 was used to determine the PMF and ½PMF and other percentages of the PMF. Those percentages were 10%, 20%, 30%, 40%, 60%, 70% and 80%. From flood routing analyses, it appears that the dam will be overtopped when the flood exceeds 6% of the PMF.

The present sluiceways are adequate to provide for effective drawdown of the reservoir. With the gates in the full open position, and no inflow considered, drawdown to the invert of the culvert may be accomplished in 3 hours (See computations sheet #4).

The 50 year storm was determined in the study entitled "Hydrology Investigation and Hydraulic Computations For Records Pond - Sussex County", dated October 1970. According to this report, the existing structure is not capable of passing the 50 year flood even with all four gates completely opened.

b. Experience Data- No gage recording information was made available.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation

1. Causeway - Erosion of the downstream slope was apparent. A considerable number of pot holes were observed on the roadway surface. Large trees, brush and dumped waste concrete line both downstream slopes.

2. Bridge/Box Culverts - Aggregate is exposed in the concrete but no serious cracking was observed. A full inspection of the timber gates was not possible since overflow was occurring but the hand operated controls and the timber gate stems were in satisfactory condition. Large trees are directly adjacent to the structure.

3. Wingwalls - Aggregate is also exposed along both upstream wingwalls, but the visible portions showed no cracking or structural deficiences.

b. Design and Construction Data - A "Preliminary Survey of the Willow Street Bridge" was provided by the State of Delaware, Division of Soil and Water Conservation. (See appendix). The information contained provided "as built" dimensions but does not give complete foundation data.

c. Operating Records - No operating records were made available.

d. Post Construction Changes - The "Preliminary Survey of Willow Street Bridge" indicates that winches were initially used to raise and lower the timber gates. As stated on sheet #2 of this report:

> "Gate winches shown above are no longer used. Gates are raised and lowered by a wooden frame attached to the gate."

A spillway gate at the southwest corner of Records Pond has been abandoned and is inoperable. However, low banks still categorize this corner of the reservoir and it is expected that these banks act as an additional spillway during severe flood.

e. Seismic Stability - The structure is located in relatively featureless topography within the Atlantic Coastal Plain physiographic province of southern Delaware. Relief in the general area ranges from elevation 5 to 40 MSL datum. The dam is founded in Recent alluvium and abuts on silty to clayey sandy unconsolidated sediments of the Pleistocene Columbia formation. Bedrock is of no consideration in the foundation of this dam.

An assessment of the dam's vulnerability to seismic events indicates that the structure is located in Seismic Zone 1. This zone presents no hazard from earthquake activity when static stability conditions are satisfactory. Accordingly, Records Pond Dam is considered seismically stable.

f. Evaluation - Based upon the visual inspection, the dam appears stable. However, when subjected to a period of prolonged overtopping, it is probable that the embankments would fail. A previous visual inspection conducted in 1970 by the Delaware Division of Highways stated:

> "Visual inspection reveals that the facility is structurally sound. There are no signs of distress and it appears to have been adequately maintained."

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - Although the culvert/causeway may be structurally sound, it is adequate to pass only six (6) per cent of the PMF without overtopping the roadway embankment. During the period of overtopping, failure of the embankment is probable.

Residential and industrial properties are immediately downstream as is the confluence with Rossakatum Branch. A bridge is situated just downstream of this confluence and could act as a control structure in the event of flooding, (See Photograph #A-4).

b. Adequacy of Information - Adequate information is not available for a complete stability analysis of the structure.

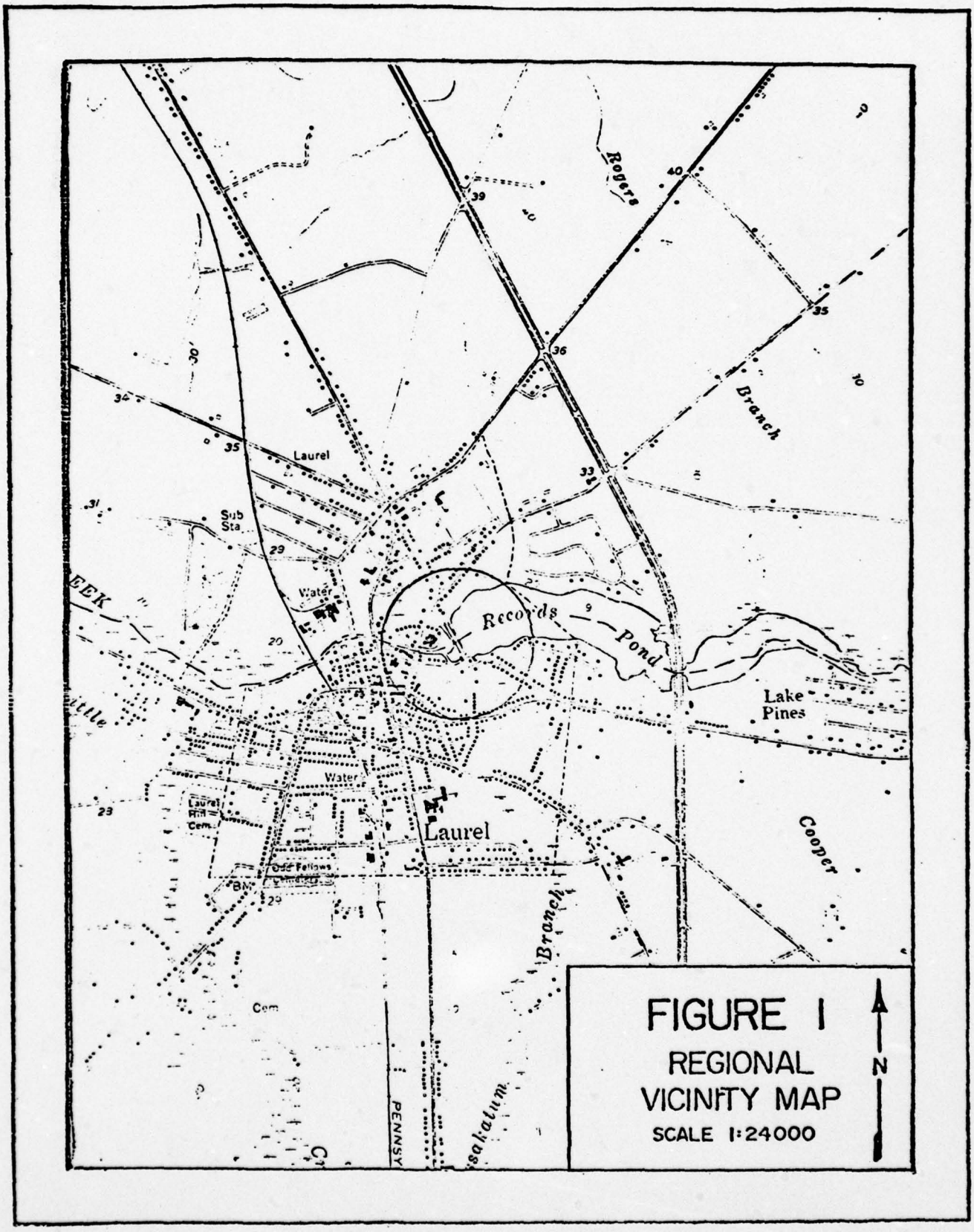
7.2 REMEDIAL MEASURES

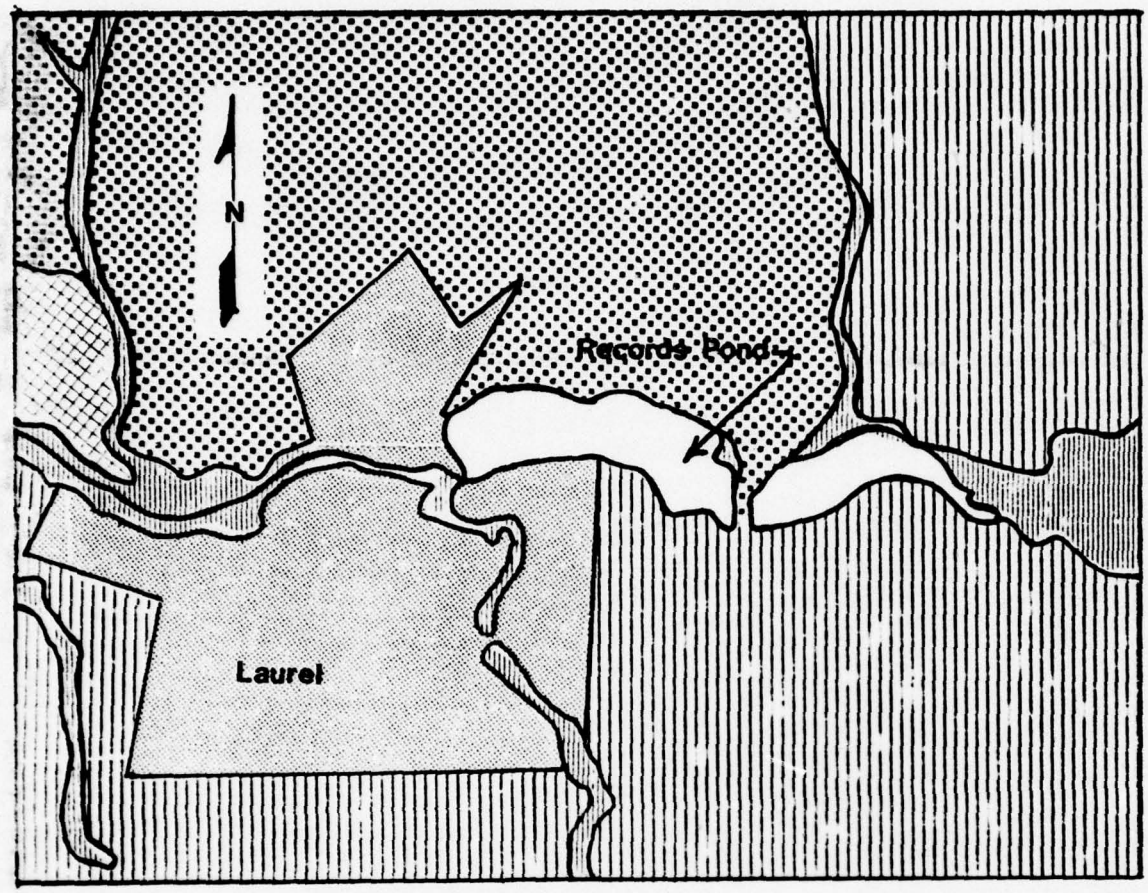
a. In order to satisfy criteria established by the Department of the Army, Office of the Chief Engineer, remedial measures that should be considered include; providing an additional waterway to pass at least $\frac{1}{2}$ of the PMF without overtopping the embankments.

Bank stabilization measures should be taken or drainage facilities provided to eliminate erosion along the downstream slope of the Willow Street causeway.

Large trees adjacent to the present abutments and wingwalls should be removed.

b. O&M Maintenance & Procedures - A flood warning system and evacuation plan is recommended.


Rogers
Branch
Laurel
Sub Sta
Water
Records
Pond
Lake Pines
Laurel
Cooper
Branch
PENNSY
FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24000
N



AM2/24 - Sandy soil

AM2/23 - Poorly graded sandy soil

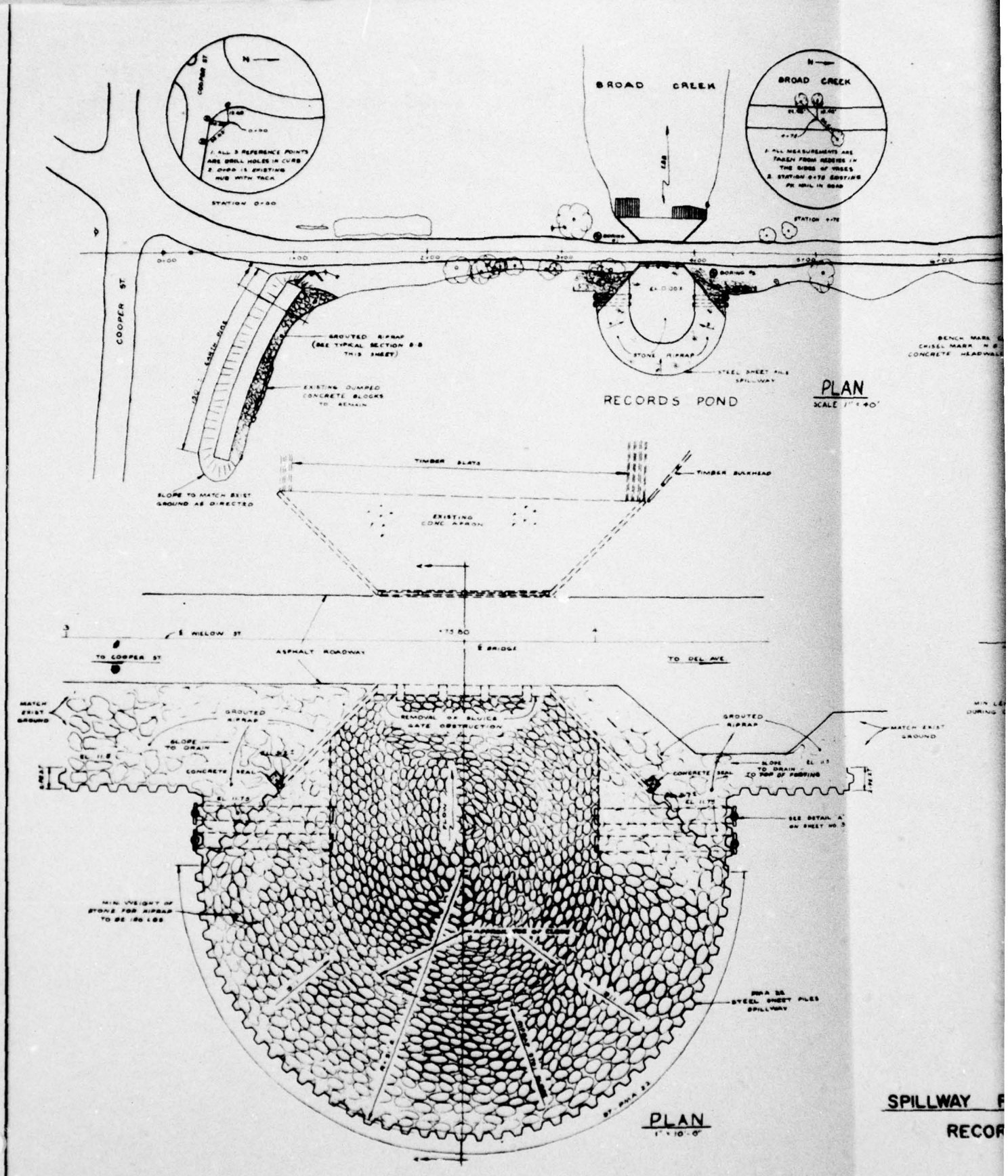
AR Z - Alluvial gravel, silt, sand and clay

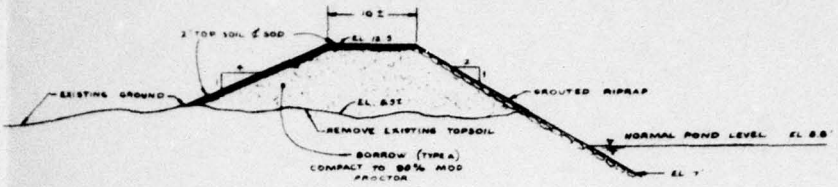
AM12/24 - Gravelly and sandy soil

Laurel, DE

Figure 2

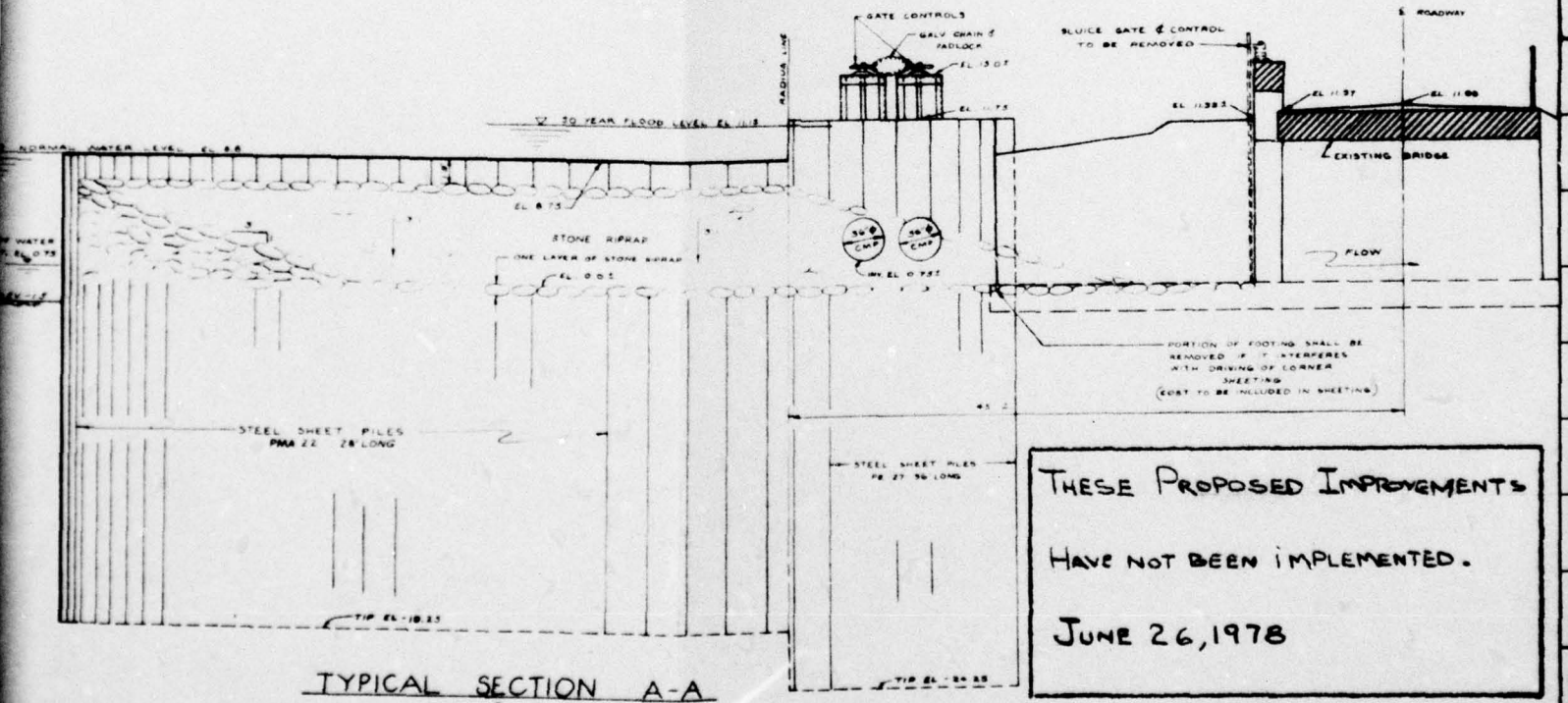
Geological Map


BROAD CREEK
COOPER ST
STATION 0+30
STATION 0+75
GROUTED RIPRAP (SEE TYPICAL SECTION B-B THIS SHEET)
EXISTING DUMPED CONCRETE BLOCKS TO REMAIN
STONE RIPRAP
STEEL SHEET PILE SPILLWAY
RECORDS POND
PLAN
SCALE 1" = 40'
TIMBER PLATS
TIMBER BULKHEAD
EXISTING CONC APRON
SLOPE TO MATCH EXIST GROUND AS DIRECTED
E WILLOW ST
TO COOPER ST
ASPHALT ROADWAY
E BRIDGE
TO DEL AVE
MATCH EXIST GROUND
GROUTED RIPRAP
REMOVAL OF SLUICE GATE OBSTRUCTION
SLOPE TO DRAIN
CONCRETE SEAL
SEE DETAIL 'A' ON SHEET NO 3
MIN WEIGHT OF STONE FOR RIPRAP TO BE 150 LBS
PLAN
1" = 10'-0"
SPILLWAY
RECOR



TYPICAL EMBANKMENT SECTION B-B

(ADJACENT TO COOPER STREET)
NOT TO SCALE



TYPICAL SECTION A-A

SCALE 1/2" = 1'-0"

THESE PROPOSED IMPROVEMENTS

HAVE NOT BEEN IMPLEMENTED.

JUNE 26, 1978

8 SECTION

POND

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY

ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970 AND ALL RULES AND REGULATIONS THERETO APPURTENANT

DIVISIONS	CHECKED BY DATE

EDWARD H. RICHARDSON ASSOCIATES, INC.
CONSULTING ENGINEERS NEWARK, DELAWARE

APPROVED BY

SCALE AS NOTED	DRAWN BY: D.H
DESIGNED BY: C.H	CHECKED BY: A.J.G
DATE: 1-9-78 COMM. NO. 2018-012	FILE NO. F-003 SHEET NO. 3 OF 4

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

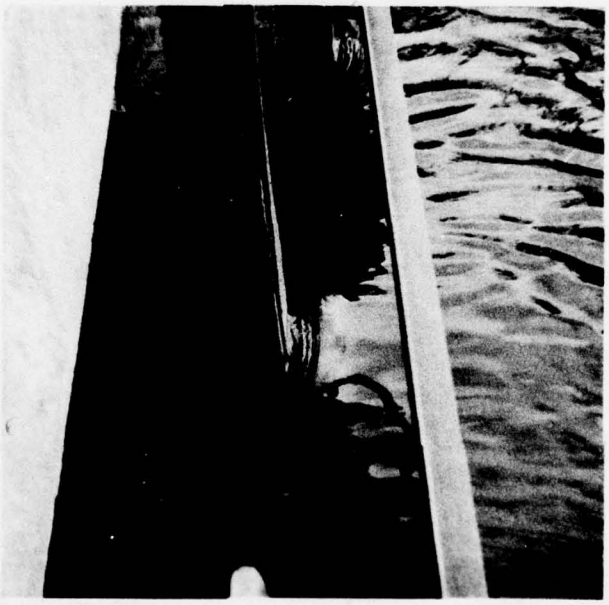
2

FIGURE 3

APPENDIX

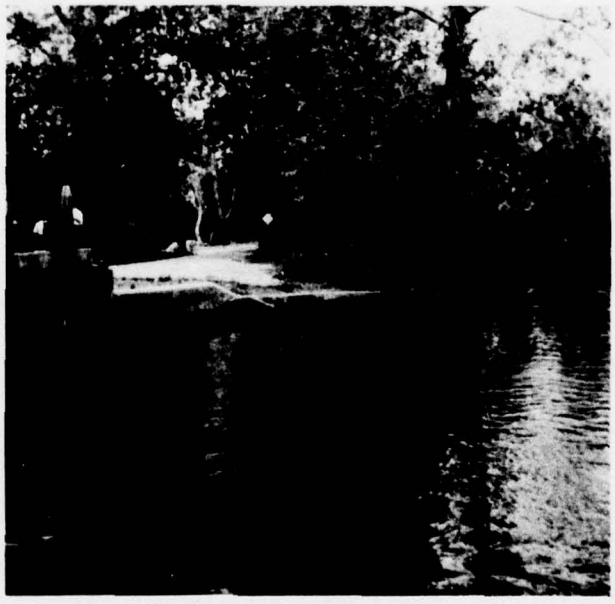
PHOTOGRAPHS

TYPICAL GATE CONTROL



OVERFLOW AT TIME OF INSPECTION

UPSTREAM LEFT BANK



UPSTREAM RIGHT BANK

DOWNSTREAM RESIDENCES, LEFT BANK

DOWNSTREAM BRIDGE AND INDUSTRIAL PROPERTY,
RIGHT BANK

FIELD INSPECTION REPORT

Check List
Visual Inspection
Phase 1

Name Dam Records Pond Dam County Sussex State Delaware Coordinators Mr.Krishna Patel

Date(s) Inspection May 24. 1978 Weather Overcast Temperature 65°

Pool Elevation at Time of Inspection 8.8 M.S.L. Tailwater at Time of Inspection 1.0 (approx.) M.S.L.

Inspection Personnel:

Mr. George C. Elias

Mr. Frank E. Falcone

Mr. Richard E. Horvath

Mr. Frank E. Falcone Recorder

Mr. Krishna Patel
Division Engineer
State of Delaware
Division of Soil and Water Conservation

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Aggregate is exposed approximately 8 feet below the roadway on the downstream face of the culvert and along both wing walls, no severe cracking.	None.
STRUCTURAL CRACKING	No sévere cracking observed.	None.
VERTICAL AND HORIZONTAL ALIGNMENT	Good condition.	None.
MONOLITH JOINTS	No appreciable cracking or separation.	None.
CONSTRUCTION JOINTS	No appreciable cracking or separation.	None.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	None observed.	The entire structure could not be inspected since overflow was occupying.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Aggregate is exposed approximately 8 feet below the roadway surface but no severe cracking was visible.	The invert of the four cell box culvert should be inspected under minimum flow conditions.
DRAINS	None observed.	None.
WATER PASSAGES	None.	None.
FOUNDATION	Unobserved, no plans available.	None.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
EMBANKMENT EROSION	Some erosion of downstream face due to surface runoff.	Downstream bank should be stabilized.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Large trees are growing immediately adjacent to the wing walls.	These trees should be removed to prevent undermining.
ANY NOTICEABLE SEEPAGE	None observed.	None.
STAFF GAGE AND RECORDER	None present.	None.
DRAINS	None provided.	None.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel forms a pool and is the confluence between Broad Creek and Rossakatum Branch. Just downstream of the confluence, an existing low bridge may cause a constriction.	Both residential and industrial properties are present along the banks of this downstream pool. Due to lack of storage in Record's Pond, the area is traditionally prone to flooding
SLOPES	Well defined and stable.	None.
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 8 homes with a population of 35 on the left bank and one industrial site on the right bank. More severe flooding could affect 1,000 people.	Traditionally prone to flooding.

ITEM	REMARKS
DESIGN REPORTS	No design reports available.
GEOLOGY REPORTS	No geology reports available except "Water-Table, Surface-Drainage, and Engineering Soils Map of the Laurel Area, Delaware" published by the U.S. Geological Survey.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	"Preliminary Survey of Willow Street Bridge" dated October 1970. "Additional Survey of Bridges over Broad Creek" dated October 1970. "Hydrology Investigation and Hydraulic Computation for Records Pond. "Sussex County" dated October, 1970.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None provided.
POST-CONSTRUCTION SURVEYS OF DAM	Investigation of Records Pond Water Control Structure by the Delaware Department of Highways dated November 11, 1970.
BORROW SOURCES.	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	Water level in Records Pond monitored by employees of the Division of Fish and Wildlife, Delaware Department and Natural Resources and Environmental Control.
MODIFICATIONS	Winches originally installed to operate the timber gates have been removed. Gates are now manually operated.
HIGH POOL RECORDS	None available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Investigation of the Records Pond Water Control Structure by the Delaware Department of Highways dated November 1970 recommended the addition of a semi-circular weir to effectively pass the 50-year flood. This plan was expanded and is shown in Figure #3.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	No reports available but downstream pool/confluence with Rossakatum Branch is traditionally a flood prone area.
MAINTENANCE OPERATION RECORDS	None available. The structure is operated and maintained by the Division of Fish and Wildlife, Department of Natural Resources and Environmental Control.

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	See Appendix.
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	See Appendix.

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	No concrete sill spillway, water flows over four timber gates.	These gates were not observed, since six to ten inches of flow was occurring over them at the time of inspection.
APPROACH CHANNEL	No approach channel.	None.
DISCHARGE CHANNEL	Well defined four cell box culvert in good condition, hydraulic jump occurs downstream.	None.
BRIDGE AND PIERS	Good condition.	None.
GATES AND OPERATION EQUIPMENT	Four hand operated timber gates mounted on timber stems operated in the event of rainfall, even minor rainfall.	Gates should be inspected in the raised position during low flow conditions.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gently rising, grass, brush and tree-lined; well defined and stable.	Southwest corner should be built up to allow for greater storage. Proposed plan is shown in Figure #3.
SEDIMENTATION	Not observed.	Should be inspected during low flow or drawdown conditions.

HYDROLOGIC & HYDRAULIC

JUSTIN & COURTNEY, INC.
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. 1 OF _____
DATE 7/18/78
NAME OF CLIENT _____
COMP. BY FEF
PROJECT RECORDS POND DAM
CHECKED BY DBC

STAGE DISCHARGE RELATIONSHIP

1. CRITICAL DEPTH @ CULVERT, USE $CLH^{3/2}$ = Q FROM EL. 1.13 TO EL. 9.16
2. PRESSURE FLOW FROM EL. 9.16 TO 26.16
3. WEIR FLOW OVER ROADWAY FROM 10.66 TO 26.16

1. $Q = CLH^{3/2}$ $C = 3.2$
$L = 4 \times 7.21 = 28.84$, $CL = 92.29$

ELEVATION	HEAD	$H^{3/2}$	DISCHARGE
1.13	0	0	0
2.13	1.0	1.0	92.3
4.13	3.0	5.2	479.9
6.13	5.0	11.2	1033.6
8.13	7.0	18.5	1707.4
8.80	7.67	21.2	1956.6

2. PRESSURE FLOW, USE $Q = CA\sqrt{2gH}$ $C = .6$ $A = 4 \times 7.21 \times 7.67 = 221.2$ SQ. FT.
@ EL. = 4.97

ELEVATION	HEAD (FM. @ OF CULV.)	$\sqrt{2gH}$	DISCHARGE
8.8	3.83	15.7	2083.7
9.66	4.69	17.4	2309.3
10.16	5.19	18.3	2428.8
10.66	5.69	19.1	2535.0
11.16	6.19	20.0	2654.4
12.16	7.19	21.5	2853.5
13.16	8.19	23.0	3052.6
14.16	9.19	24.3	3225.1
20.16	15.19	31.3	4154.1
26.16	21.19	36.9	4897.4

3. WEIR FLOW OVER ROADWAY C = 3.0
L = 500' ; CL = 1500

ELEVATION	HEAD	$H^{3/2}$	DISCHARGE
10.66	0	0	0
11.16	0.5	0.35	525.0
12.16	1.5	1.84	2760.0
13.16	2.5	3.95	5925.0
14.16	3.5	6.55	9825.0
20.16	9.5	29.28	43920.0
26.16	15.5	61.02	91530.0

TOTAL DISCHARGE

ELEVATION	CULVERT Q.	PRESSURE Q.	ROADWAY Q.	TOTAL Q.
1.13	0			0
2.13	92.3			92.3
4.13	479.9			479.9
6.13	1033.6			1033.6
8.13	1707.4			1707.4
8.80	1956.6			1956.6
9.66		2309.3		2309.3
10.16		2428.8		2428.8
10.66		2535.0		2535.0
11.16		2654.4	525.0	3179.4
12.16		2853.5	2760.0	5613.5
13.16		3052.6	5925.0	8977.6
14.16		3225.1	9825.0	13050.1
20.16		4154.1	43920.0	48074.1
26.16		4897.4	91530.0	96427.4

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PHILADELPHIA, PA

SHEET NO. 2A OF _____

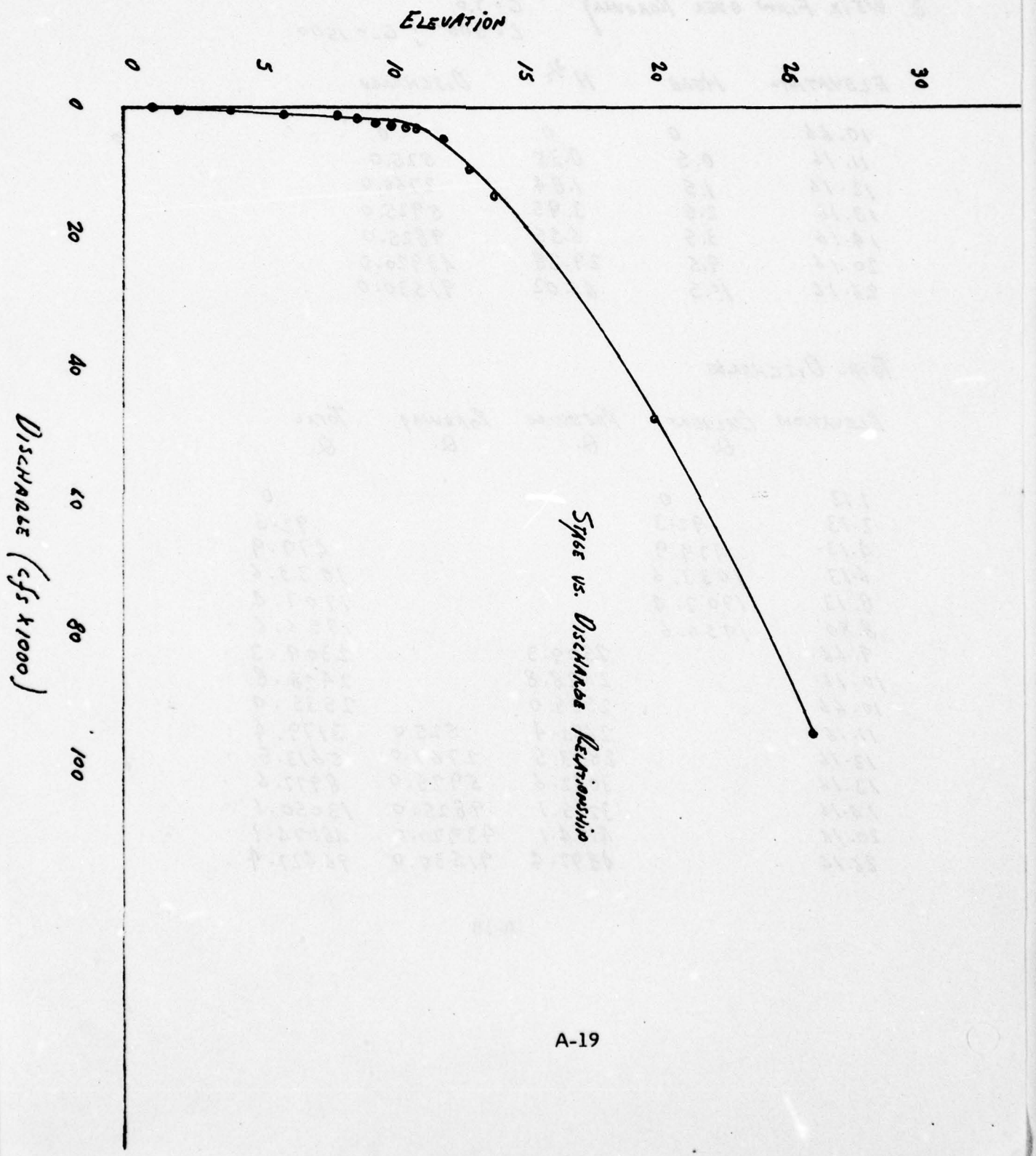
DATE 7/18/78

NAME OF CLIENT _____

COMP. BY PAF

PROJECT Recons Bond Dam

CHECKED BY _____



STAGE/STORAGE RELATIONSHIP

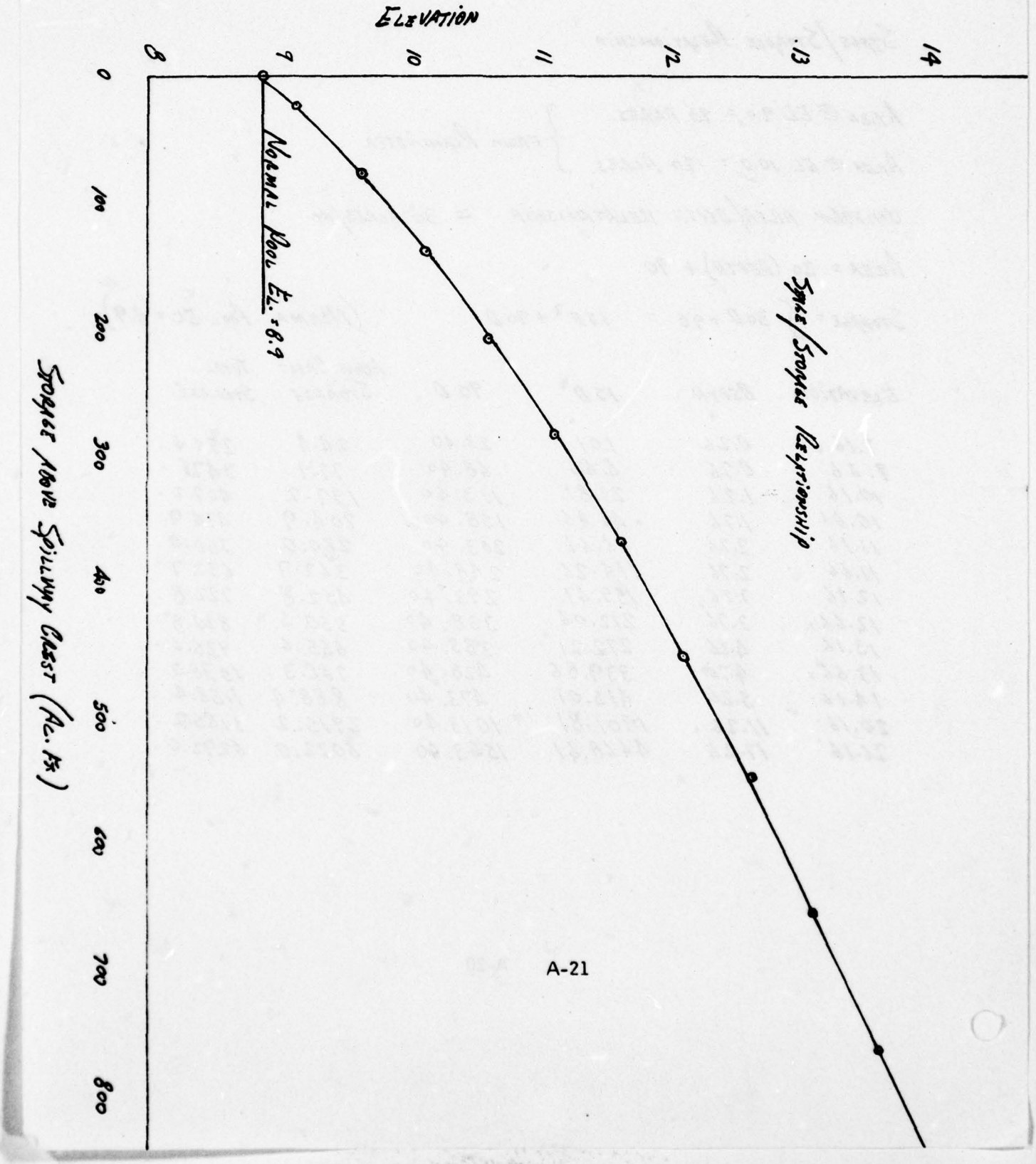
AREA @ EL 9.0 = 90 ACRES.
AREA @ EL. 10.0 = 120 ACRES. } FROM PLANIMETER

UNIFORM AREA/DEPTH RELATIONSHIP = 30 ACRES/FT.

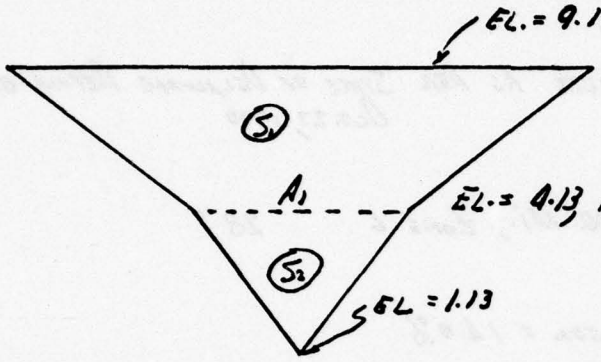
AREA = 30 (DEPTH) + 90

STORAGE = $\int 30D + 90 = 15D^2 + 90D$ (NORMAL POOL EL. = 8.9)

ELEVATION	DEPTH	$15D^2$	90 D	ABOVE CREST STORAGE	TOTAL STORAGE
9.16	0.26	1.01	23.40	24.4	294.4
9.66	0.76	8.66	68.40	77.1	347.1
10.16	1.26	23.81	113.40	137.2	407.2
10.66	1.76	46.46	158.40	204.9	474.9
11.16	2.26	76.61	203.40	280.0	550.0
11.66	2.76	114.26	248.40	362.7	632.7
12.16	3.26	159.41	293.40	452.8	722.8
12.66	3.76	212.06	338.40	550.5	820.5
13.16	4.26	272.21	383.40	655.6	925.6
13.66	4.76	339.86	428.40	768.3	1038.3
14.16	5.26	415.01	473.40	888.4	1158.4
20.16	11.26	1901.81	1013.40	2915.2	3185.2
26.16	17.26	4468.61	1553.40	6022.0	6292.0


ELEVATION
8
9
10
11
12
13
14
0
100
200
300
400
500
600
700
800
NORMAL POOL EL. 8.9
STORAGE / ELEVATION RELATIONSHIP
STORAGE ABOVE SPILLWAY CREST (AC. FT.)

DRAWDOWN COMPUTATIONS



@ NORMAL POOL:
EL. = 8.9
STORAGE = 270 AC.FT.
AREA = 90 ACRES.

EQ.1) $(98 + A_1)/2 \times 5.03 = S_1$

EQ.2) $(A_1 + 0)/2 \times 3 = S_2$

E.3) $S_1 + S_2 = 270$ Ac. Ft.

→ $S_1 = 261$ Ac. Ft.; $S_2 = 9$ Ac. Ft.

FOR DISCHARGE DETERMINATION, USE $Q = CLH^{3/2}$ (NO TAILWATER ASSUMED).

$C = 3.1$, $L = 4 \times 7.21 = 28.84$; $CL = 89.40$

ELEV. (TOP)	ELEV. (LOW)	ELEV. (AVE.)	HEAD	DISCHARGE	INCR. STORAGE	TIME (SEC/HR.)
9.16	6.13	7.65	6.52	1488.4	212	6206/1.72
6.13	4.13	5.13	4.00	715.2	49	2984/0.83
4.13	1.13	2.63	1.50	164.2	9	2388/0.66

→ @ EL. 6.13:

AREA = $18.29 D + 6 = 42.6$ ACRES

STORAGE = $\left(\frac{18.29}{2}\right) D^2 + 6D = 48.6$ A.F. ≈ 49 A.F.

TOTAL DRAWDOWN TIME = 3.21 HRS.

SAY 3 HRS.

PROBABLE MAXIMUM FLOOD COMPUTATIONS

DRAINAGE AREA = 73.1 SQ. MILES AS PER STATE OF DELAWARE REPORT DATED OCT. 27, 1970

PMP = 6 HR. DURATION, 10 SQ. MI., ZONE 6 28"

ISOHYETAL FIT REDUCTION FACTOR = 14.0%

DEPTH, AREA DURATION ADJUSTMENT = 82.0%

ADJUSTED PMP = 28" x 82% x 86% = 19.75"

TIME (HRS).	% 6 HR. PMP	Σ 6 HR. PMP	INCR. PMP	DESCENDING ORDER	DISTRIBUTION
0.5	30	5.93	5.93	5.93	0.59
1.0	49	9.68	3.75	3.75	0.59
1.5	58	11.46	1.78	1.78	0.99
2.0	65	12.84	1.38	1.38	0.99
2.5	70	13.83	0.99	0.99	0.99
3.0	75	14.81	0.98	0.99	0.99
3.5	80	15.80	0.99	0.99	3.75
4.0	85	16.79	0.99	0.99	5.93
4.5	88	17.38	0.59	0.98	1.78
5.0	93	18.37	0.99	0.79	1.38
5.5	96	18.96	0.59	0.59	0.98
6.0	100	19.75	0.79	0.59	0.79

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PHILADELPHIA, PA

SHEET NO. 7 OF _____
DATE 7/18/78
COMP. BY F&F.
CHECKED BY DBC

NAME OF CLIENT _____
PROJECT Records Pond Dam

RAINFALL/RUNOFF DISTRIBUTION CN = 70 * Minimum Loss Rate = 1"/.5 Hr.

TIME (HRS)	RAINFALL		RUNOFF		LOSSES	
	INCR.	SUMMATION	INCR.	SUMMATION	INCR.	SUMMATION
0.5	0.59	0.59	0	.018	0.59	0.59
1.0	0.59	1.18	.01	.023	0.58	1.17
1.5	0.99	2.17	.29	.308	0.70	1.87
2.0	0.99	3.16	.50	.805	0.49	2.36
2.5	0.99	4.15	.63	1.431	0.36	2.72
3.0	0.99	5.14	.71	2.141	0.28	3.00
3.5	3.75	8.89	3.10	5.238	0.65	3.65
4.0	5.93	14.82	5.45	10.684	0.48	4.13
4.5	1.78	16.60	1.68 *	12.374	0.10 *	4.23
5.0	1.38	17.98	1.28 *	13.695	0.10 *	4.33
5.5	0.98	18.96	.88 *	14.628	0.10 *	4.43
6.0	0.79	19.75	.69 *	15.400	0.10 *	4.53

$C_T = 0.90$

$L = 12.97$ Miles

$L_{CA} = 5.96$ Miles

$T_p = C_T(L L_{CA})^{.3} = 0.9(12.97 \times 5.96)^{.3} = .9 \times 3.69 = 3.32$

$C_p = 310/640 = 0.48$ U.S. Army Engineer Districts, Philadelphia

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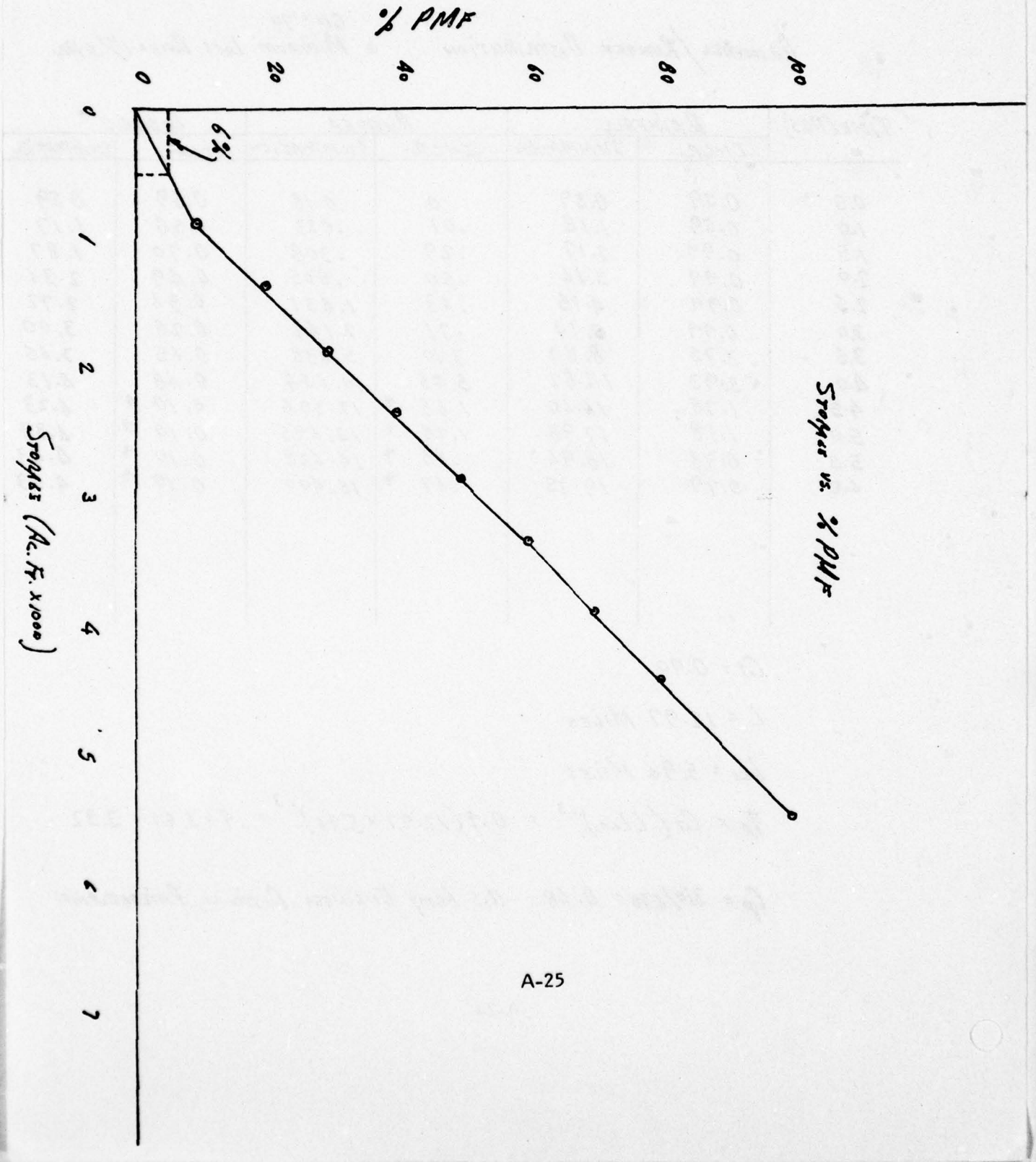
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. 8 OF _____
DATE 7/18/78
COMP. BY FBE
CHECKED BY _____

NAME OF CLIENT _____
PROJECT Records Pond Dam



DBC

HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01

PMF ROUTING
RECORDS POND DAM
O'BRIEN + GERE - JUSTIN + COURTNEY DIV.

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
48	0	30	1	0	0	0	0	2	0

JOPER	NWT
5	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .10 .20 .30 .40 .50 .60 .70 .80 1.00

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IJHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	1	73.10	0.00	0.00	0.00	0.000	0	1	0

PRECIP DATA

NP	STORM	DAJ	DAK
12	0.00	0.00	0.00

PRECIP PATTERN

0.00 .01 .29 .50 .63 .71 3.10 5.45 1.68 1.28
.88 .69

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 3.52 CP= .48 NTA= 0

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.59 AND R=10.05 INTERVALS

UNIT HYDROGRAPH 58 END-OF-PERIOD ORDINATES, LAG= 3.53 HOURS, CP= .48 VOL= 1.00

302.	1128.	2289.	3630.	4924.	5908.	6471.	6465.	5990.	5422.
4908.	4443.	4021.	3640.	3295.	2983.	2700.	2444.	2212.	2003.
1813.	1641.	1485.	1345.	1217.	1102.	997.	903.	817.	740.
670.	606.	549.	497.	450.	407.	368.	333.	302.	273.
247.	224.	203.	183.	166.	150.	136.	123.	111.	101.
91.	83.	75.	68.	61.	56.	50.	45.		

1	0	60	.01	.01	3.
1	1	30	.29	.29	99.
1	1	60	.50	.50	501.
1	2	30	.63	.63	1455.
1	2	60	.71	.71	3172.
1	3	30	3.10	3.10	6482.
1	3	60	5.45	5.45	13296.
1	4	30	1.68	1.68	24326.
1	4	60	1.28	1.28	38398.
1	5	30	.88	.88	53497.
1	5	60	.69	.69	68663.
1	6	30	0.00	0.00	80510.
1	6	60	0.00	0.00	87760.
1	7	30	0.00	0.00	89437.
1	7	60	0.00	0.00	86575.
1	8	30	0.00	0.00	81365.
1	8	60	0.00	0.00	75138.
1	9	30	0.00	0.00	68555.
1	9	60	0.00	0.00	62151.
1	10	30	0.00	0.00	56259.
1	10	60	0.00	0.00	50926.
1	11	30	0.00	0.00	46098.
1	11	60	0.00	0.00	41728.
1	12	30	0.00	0.00	37772.
1	12	60	0.00	0.00	34191.
1	13	30	0.00	0.00	30950.
1	13	60	0.00	0.00	28016.
1	14	30	0.00	0.00	25360.
1	14	60	0.00	0.00	22956.
1	15	30	0.00	0.00	20780.
1	15	60	0.00	0.00	18810.
1	16	30	0.00	0.00	17027.
1	16	60	0.00	0.00	15412.
1	17	30	0.00	0.00	13951.
1	17	60	0.00	0.00	12629.
1	18	30	0.00	0.00	11432.
1	18	60	0.00	0.00	10348.
1	19	30	0.00	0.00	9367.
1	19	60	0.00	0.00	8479.
1	20	30	0.00	0.00	7675.
1	20	60	0.00	0.00	6947.
1	21	30	0.00	0.00	6289.
1	21	60	0.00	0.00	5693.
1	22	30	0.00	0.00	5153.
1	22	60	0.00	0.00	4664.
1	23	30	0.00	0.00	4222.
1	23	60	0.00	0.00	3822.
		SUM	15.22	15.22	1398739.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	89437.	71770.	29140.	29140.	1398736.
INCHES		9.13	14.83	14.83	14.83
AC-FT		35607.	57829.	57829.	57829.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

0.	0.	10.	50.	145.	317.	648.	1330.	2433.	3840.
5390.	6866.	8051.	8776.	8944.	8657.	8137.	7514.	6855.	6215.
5626.	5093.	4610.	4173.	3777.	3419.	3095.	2802.	2536.	2296.
2078.	1881.	1703.	1541.	1395.	1263.	1143.	1035.	937.	848.
768.	695.	629.	569.	515.	466.	422.	382.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8944.	7177.	2914.	2914.	139874.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

0.	1.	20.	100.	291.	634.	1296.	2659.	4865.	7680.
10779.	13733.	16102.	17552.	17887.	17315.	16273.	15028.	13711.	12430.
11252.	10185.	9220.	8346.	7554.	6838.	6190.	5603.	5072.	4591.
4156.	3762.	3405.	3082.	2790.	2526.	2286.	2070.	1873.	1696.
1535.	1389.	1258.	1139.	1031.	933.	844.	764.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	17887.	14354.	5828.	5828.	279747.
INCHES		1.83	2.97	2.97	2.97
AC-FT		7121.	11566.	11566.	11566.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

0.	1.	30.	150.	436.	951.	1945.	3989.	7298.	11519.
16169.	20599.	24153.	26328.	26831.	25972.	24410.	22541.	20566.	18645.
16878.	15278.	13829.	12518.	11332.	10257.	9285.	8405.	7608.	6887.
6234.	5643.	5108.	4624.	4185.	3789.	3429.	3104.	2810.	2544.
2303.	2084.	1887.	1708.	1546.	1399.	1267.	1147.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	26831.	21531.	8742.	8742.	419621.
INCHES		2.74	4.45	4.45	4.45
AC-FT		10682.	17349.	17349.	17349.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

0.	1.	40.	200.	582.	1269.	2593.	5318.	9730.	15359.
21559.	27465.	32204.	35104.	35775.	34630.	32546.	30055.	27422.	24860.
22504.	20370.	18439.	16691.	15109.	13677.	12380.	11206.	10144.	9182.
8312.	7524.	6811.	6165.	5581.	5051.	4573.	4139.	3747.	3392.
3070.	2779.	2516.	2277.	2061.	1866.	1689.	1529.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	35775.	28708.	11656.	11656.	559494.
INCHES		3.65	5.93	5.93	5.93
AC-FT		14243.	23132.	23132.	23132.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5

0.	2.	49.	251.	727.	1586.	3241.	6648.	12163.	19199.
26949.	34331.	40255.	43880.	44719.	43287.	40663.	37569.	34277.	31076.
28130.	25463.	23049.	20864.	18886.	17096.	15475.	14008.	12680.	11478.
10390.	9405.	8513.	7706.	6976.	6314.	5716.	5174.	4683.	4239.
3838.	3474.	3144.	2846.	2576.	2332.	2111.	1911.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	44719.	35885.	14570.	14570.	699368.
INCHES		4.57	7.42	7.42	7.42
AC-FT		17803.	28914.	28914.	28914.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 6

0.	2.	59.	301.	873.	1903.	3889.	7978.	14596.	23039.
32339.	41198.	48306.	52656.	53662.	51945.	48819.	45083.	41133.	37291.
33755.	30555.	27659.	25037.	22663.	20515.	18570.	16810.	15216.	13773.
12468.	11286.	10216.	9247.	8371.	7577.	6859.	6209.	5620.	5087.
4605.	4168.	3773.	3416.	3092.	2799.	2533.	2293.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	53662.	43062.	17484.	17484.	839242.
INCHES		5.48	8.90	8.90	8.90
AC-FT		21364.	34697.	34697.	34697.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 7

0.	2.	69.	351.	1018.	2220.	4537.	9307.	17028.	26878.
37728.	48064.	56357.	61432.	62606.	60602.	56956.	52596.	47988.	43506.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	62606.	50239.	20398.	20398.	979115.
INCHES		6.39	10.38	10.38	10.38
AC-FT		24925.	40480.	40480.	40480.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 8

0.	2.	79.	401.	1164.	2537.	5185.	10637.	19461.	30718.
43118.	54930.	64408.	70208.	71550.	69260.	65092.	60110.	54844.	49721.
45007.	40741.	36878.	33382.	30218.	27353.	24760.	22413.	20288.	18365.
16624.	15048.	13621.	12330.	11161.	10103.	9145.	8278.	7493.	6781.
6140.	5558.	5031.	4554.	4122.	3732.	3378.	3058.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	71550.	57416.	23312.	23312.	1118983.
INCHES		7.31	11.87	11.87	11.87
AC-FT		28485.	46263.	46263.	46263.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 9

0.	3.	99.	501.	1455.	3172.	6482.	13296.	24326.	38398.
53897.	68663.	80510.	87760.	89437.	86575.	81365.	75138.	68555.	62151.
56259.	50926.	46098.	41728.	37772.	34191.	30950.	28016.	25360.	22956.
20780.	18810.	17027.	15412.	13951.	12629.	11432.	10348.	9367.	8479.
7675.	6947.	6289.	5693.	5153.	4664.	4222.	3822.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	89437.	71770.	29140.	29140.	1398736.
INCHES		9.13	14.83	14.83	14.83
AC-FT		35607.	57829.	57829.	57829.

********** *********** ********** ********* **********

HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	1

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.000	0.000	0.000	270.

STORAGE=	0.	270.	347.	407.	550.	721.	926.	1158.	3185.	6292.
OUTFLOW=	0.	1957.	2309.	2429.	3179.	5614.	8978.	13050.	48074.	96427.

STATION 2, PLAN 1, RTIO 1

1447.	1070.	793.	594.	465.	404.	424.	571.	913.	1492.
2188.	2767.	4343.	6251.	7582.	8204.	8302.	8059.	7613.	7063.
6480.	5908.	5398.	4944.	4508.	4098.	3719.	3372.	3125.	2985.
2830.	2664.	2493.	2386.	2313.	2148.	1985.	1766.	1563.	1388.
1237.	1105.	990.	888.	798.	718.	647.	583.		

STOR

200.	148.	109.	82.	64.	56.	59.	79.	126.	206.
320.	471.	633.	761.	842.	879.	885.	871.	844.	810.
775.	741.	708.	675.	644.	615.	588.	564.	540.	513.
483.	452.	419.	385.	349.	312.	276.	244.	216.	191.
171.	152.	137.	122.	110.	99.	89.	80.		

STATION 2, PLAN 1, RTIO 2

1447.	1070.	794.	603.	497.	488.	612.	968.	1696.	2433.
4523.	8324.	11905.	14462.	16176.	16926.	16856.	16222.	15247.	14102.
12911.	11744.	10657.	9659.	8759.	7962.	7223.	6547.	5930.	5398.
4936.	4496.	4085.	3706.	3359.	3120.	2980.	2824.	2657.	2486.
2383.	2310.	2141.	1978.	1756.	1555.	1381.	1231.		

STOR

200.	148.	110.	83.	69.	67.	84.	134.	234.	408.
645.	887.	1087.	1240.	1339.	1382.	1378.	1342.	1285.	1219.
1150.	1084.	1022.	965.	913.	865.	820.	779.	742.	709.
675.	644.	614.	587.	563.	539.	512.	482.	450.	418.
384.	349.	310.	275.	242.	214.	191.	170.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	16926.	13897.	5863.	5863.	281426.
INCHES		1.77	2.98	2.98	2.98
AC-FT		6895.	11635.	11635.	11635.

STATION 2, PLAN 1, RTIO 3

1447.	1070.	795.	612.	529.	572.	800.	1364.	2303.	3955.
8781.	13874.	18347.	21974.	24397.	25452.	25315.	24347.	22877.	21156.
19370.	17638.	16015.	14520.	13155.	11900.	10767.	9744.	8826.	8021.
7276.	6594.	5972.	5432.	4969.	4527.	4113.	3732.	3383.	3129.
2991.	2835.	2669.	2499.	2388.	2315.	2153.	1990.		

STOR

200.	148.	110.	84.	73.	79.	110.	188.	346.	605.
914.	1206.	1465.	1674.	1815.	1876.	1868.	1812.	1727.	1627.
1524.	1424.	1330.	1243.	1164.	1092.	1028.	970.	917.	868.
823.	782.	745.	710.	677.	646.	616.	589.	564.	541.
514.	484.	453.	420.	387.	350.	313.	277.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25452.	20951.	8727.	8727.	418889.
INCHES		2.67	4.44	4.44	4.44
AC-FT		10394.	17318.	17318.	17318.

STATION 2, PLAN 1, RTIO 4

1447.	1070.	797.	621.	561.	656.	988.	1761.	2714.	6660.
12839.	18984.	24693.	29408.	32581.	33960.	33764.	32468.	30506.	28209.
25827.	23517.	21353.	19360.	17540.	15884.	14381.	13019.	11772.	10649.
9637.	8733.	7934.	7196.	6521.	5906.	5379.	4918.	4479.	4069.
3691.	3346.	3115.	2974.	2817.	2650.	2479.	2380.		

STOR

200.	148.	110.	86.	77.	90.	136.	243.	461.	786.
1146.	1501.	1832.	2105.	2288.	2368.	2357.	2282.	2168.	2035.
1897.	1764.	1639.	1523.	1418.	1322.	1235.	1156.	1085.	1021.
964.	911.	863.	818.	778.	741.	706.	674.	642.	613.
586.	562.	538.	511.	481.	449.	417.	383.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	33960.	27971.	11588.	11588.	556215.
INCHES		3.56	5.90	5.90	5.90
AC-FT		13877.	22996.	22996.	22996.

STATION 2, PLAN 1, RTIO 5

1447.	1070.	798.	629.	593.	740.	1176.	2090.	3493.	9450.
16660.	24016.	31002.	36824.	40757.	42465.	42212.	40588.	38134.	35262.
32284.	29397.	26692.	24200.	21924.	19855.	17977.	16274.	14733.	13336.

200.	144.	110.	87.	82.	102.	162.	299.	572.	934.	
1367.	1793.	2197.	2534.	2762.	2860.	2846.	2752.	2610.	2444.	
2271.	2104.	1948.	1803.	1672.	1552.	1443.	1345.	1255.	1175.	
1102.	1036.	977.	923.	874.	829.	787.	749.	714.	681.	
650.	620.	593.	568.	544.	518.	489.	457.			

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	42465.	34985.	14464.	14464.	694254.
INCHES		4.45	7.36	7.36	7.36
AC-FT		17357.	28703.	28703.	28703.

STATION 2, PLAN 1, RTIO 6

1447.	1070.	800.	638.	625.	824.	1363.	2329.	4919.	12044.
20287.	28959.	37268.	44220.	48860.	50779.	50586.	48817.	45873.	42368.
38767.	35288.	32036.	29043.	26311.	23826.	21572.	19529.	17679.	16004.
14497.	13113.	11857.	10726.	9706.	8792.	7989.	7247.	6567.	5948.
5413.	4950.	4509.	4097.	3717.	3369.	3124.	2985.		

STOR

200.	148.	110.	88.	86.	114.	188.	357.	674.	1101.
1577.	2079.	2560.	2962.	3235.	3359.	3346.	3233.	3058.	2855.
2646.	2445.	2257.	2084.	1925.	1782.	1651.	1533.	1426.	1329.
1241.	1162.	1090.	1026.	967.	915.	866.	822.	781.	743.
709.	676.	644.	615.	588.	564.	540.	513.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	50779.	41992.	17348.	17348.	832728.
INCHES		5.34	8.83	8.83	8.83
AC-FT		20833.	34428.	34428.	34428.

STATION 2, PLAN 1, RTIO 7

1447.	1070.	801.	647.	657.	907.	1551.	2480.	6486.	14593.
23911.	33900.	43534.	51350.	56542.	59005.	58895.	56891.	53680.	49820.
45554.	41324.	37449.	33918.	30712.	27805.	25171.	22786.	20626.	18671.
16901.	15299.	13849.	12530.	11331.	10252.	9277.	8421.	7645.	6931.
6280.	5687.	5203.	4748.	4319.	3921.	3556.	3222.		

STOR

200.	148.	110.	89.	91.	125.	214.	417.	776.	1247.
1787.	2365.	2922.	3396.	3729.	3887.	3880.	3752.	3545.	3297.
3039.	2794.	2570.	2366.	2180.	2012.	1860.	1721.	1596.	1483.
1381.	1288.	1204.	1128.	1060.	999.	943.	892.	846.	802.
763.	727.	694.	662.	631.	603.	577.	553.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	59005.	48997.	20241.	20241.	971560.
INCHES		6.24	10.30	10.30	10.30
AC-FT		24308.	40168.	40168.	40169.

STATION 2, PLAN 1, RTIO 8

1447.	1071.	802.	656.	689.	991.	1739.	2778.	8070.	17043.
27501.	38825.	49663.	59249.	64395.	67319.	67250.	64988.	61333.	56929.
52274.	47670.	43008.	38863.	35147.	31800.	28778.	26046.	23575.	21340.
19316.	17485.	15827.	14327.	12968.	11725.	10607.	9598.	8699.	7903.
7168.	6495.	5883.	5360.	4900.	4461.	4053.	3677.		

STOR

200.	148.	111.	90.	95.	137.	240.	474.	871.	1389.
1994.	2650.	3287.	3839.	4234.	4422.	4417.	4272.	4037.	3754.
3455.	3162.	2892.	2652.	2437.	2243.	2068.	1910.	1767.	1638.
[illegible]	[illegible]	1719.	1232.	1153.	1082.	1019.	961.	909.	861.

[illegible]	[illegible]	111.	48.	95.	137.	240.	474.	871.	1389.
1994.	2650.	3287.	3839.	4234.	4422.	4417.	4272.	4037.	3754.
3455.	3162.	2892.	2652.	2437.	2243.	2068.	1910.	1767.	1638.
1521.	1415.	1319.	1232.	1153.	1082.	1019.	961.	909.	861.
817.	776.	739.	705.	672.	641.	612.	585.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	67319.	55995.	23139.	23139.	1110688.
INCHES		7.13	11.78	11.78	11.78
AC-FT		27780.	45920.	45920.	45920.

STATION 2, PLAN 1, RTIO 9

1447.	1071.	805.	673.	753.	1159.	2061.	3650.	11218.	21838.
34629.	48608.	61250.	72386.	80275.	84037.	84004.	81205.	76651.	71153.
65339.	59623.	54216.	49202.	44321.	39933.	36059.	32599.	29489.	26684.
24150.	21858.	19785.	17909.	16211.	14674.	13283.	12012.	10865.	9831.
8901.	8090.	7339.	6651.	6025.	5474.	5010.	4565.		

STOR

200.	148.	111.	93.	104.	160.	293.	583.	1054.	1667.
2407.	3219.	4032.	4747.	5254.	5496.	5494.	5314.	5021.	4668.
4294.	3927.	3580.	3258.	2968.	2714.	2490.	2289.	2109.	1947.
1800.	1668.	1548.	1439.	1341.	1252.	1171.	1099.	1034.	975.
921.	872.	827.	786.	748.	713.	680.	648.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	84037.	69945.	28937.	28937.	1388971.
INCHES		8.90	14.73	14.73	14.73
AC-FT		34701.	57425.	57425.	57425.

********** ********** ********** ********** **********

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS .10	.20	.30	.40	.50	.60	.70	.80	1.00
HYDROGRAPH AT	1	1	8944.	17887.	26831.	35775.	44719.	53662.	62606.	71550.	89437.
		2	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROUTED TO	2	1	8302.	16926.	25452.	33960.	42465.	50779.	59005.	67319.	84037.
		2	0.	0.	0.	0.	0.	0.	0.	0.	0.

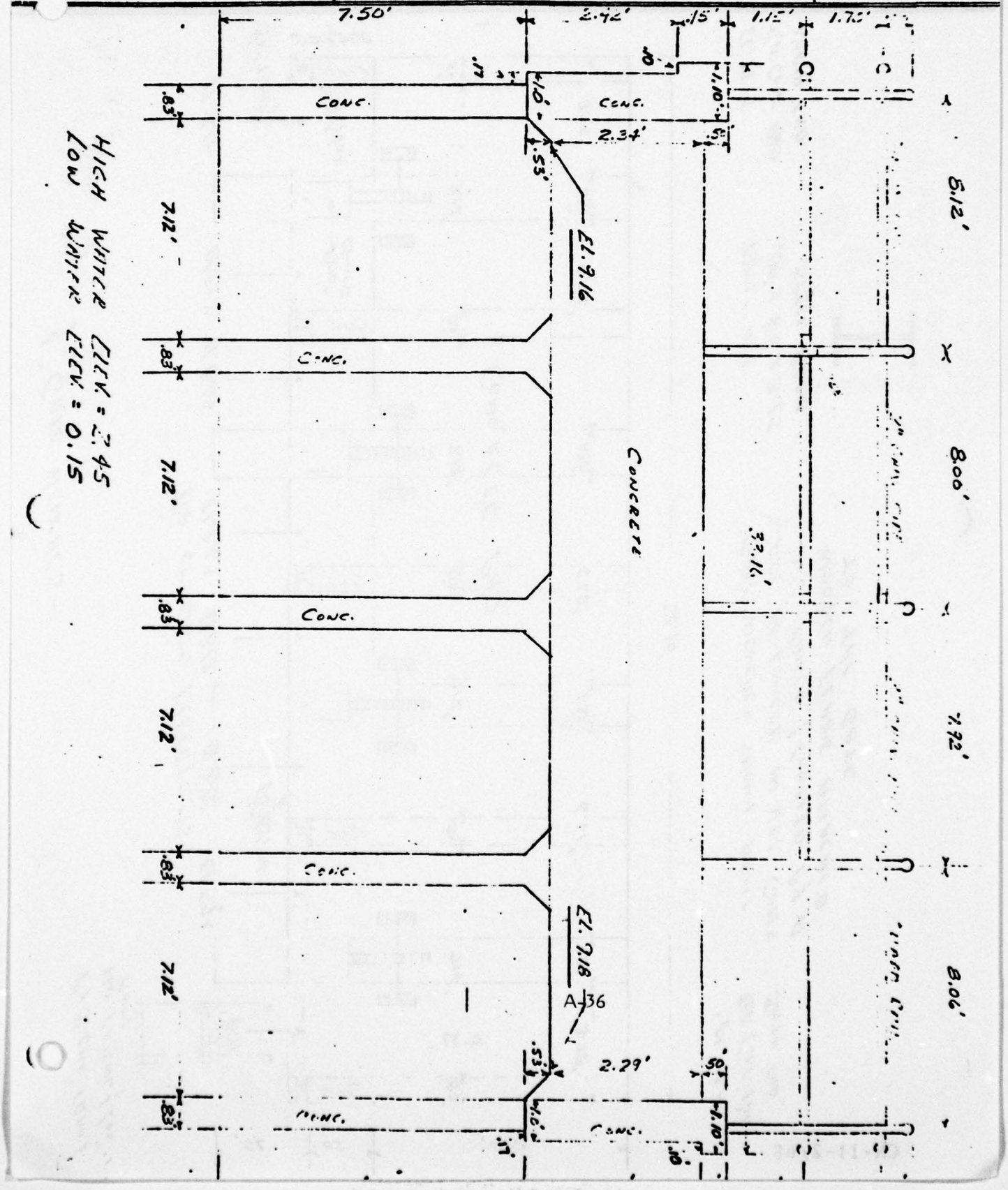
PREVIOUS REPORTS

Contract No.	DELAWARE STATE HIGHWAY DEPARTMENT	Source Document #
Item::	Field Measurements And Preliminary Calculation of Quantities	By:
		Entered In:

PRELIMINARY SURVEY
WILLOW ST BRIDGE

INDEX:

Contract No.	DELAWARE STATE HIGHWAY DEPARTMENT	Source Document #
Item:	Field Measurements And Preliminary Calculation of Quantities	By:
		Entered In:



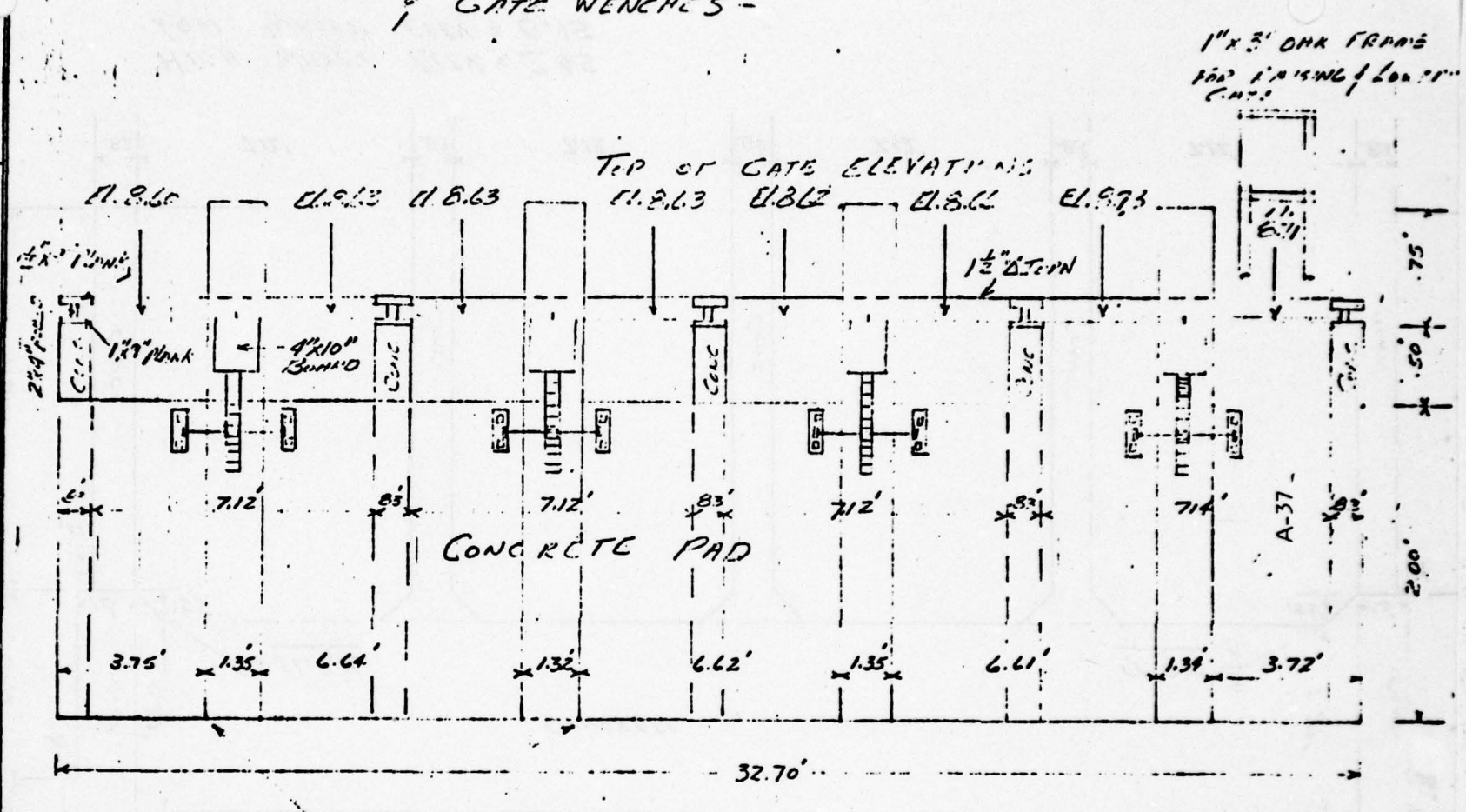
DELAWARE STATE HIGHWAY DEPARTMENT

Field Measurements And Preliminary Calculation of Quantities

Source Document #:
By:
Entered In:

Contract No.:
Item:

4 GATE WENCHES -



El. 13.95
TOP CONC. PAD
NORTH END.

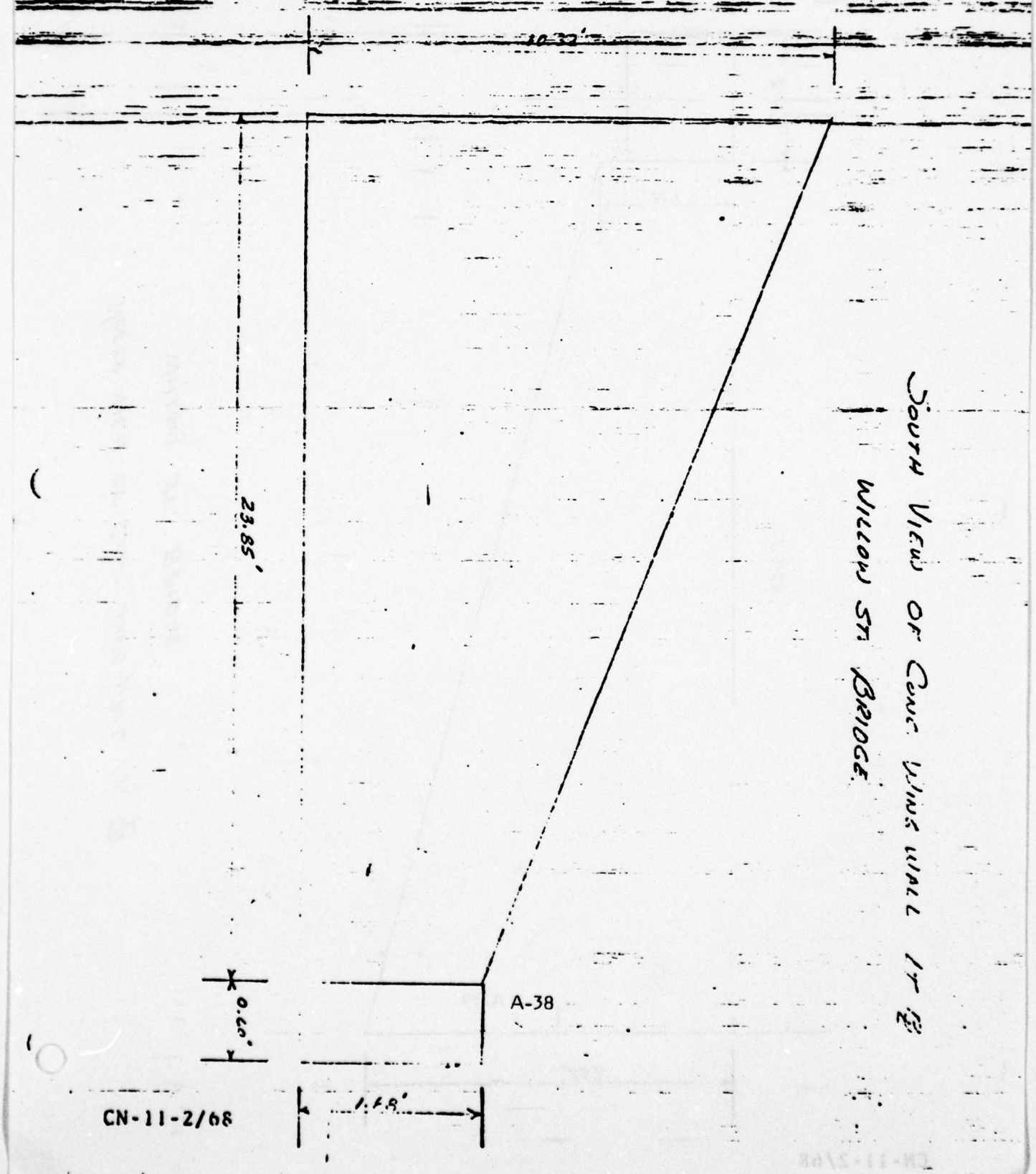
FINGER ARE
.38' x .83' x 3.25
STEEL BEAM

GATE WENCHES SHOWN ABOVE ARE NO LONGER IN USE. GATES ARE RAISED & LOWERED BY A WOODEN FRAME ATTACHED TO THE GATE

El. 14.00
TOP CONC. PAD
SOUTH END

CN-11-2/08

Item:	Field Measurements And Preliminary Calculation of Quantities	By:
		Entered In:



CN-11-2/68

Contract No.

Item:

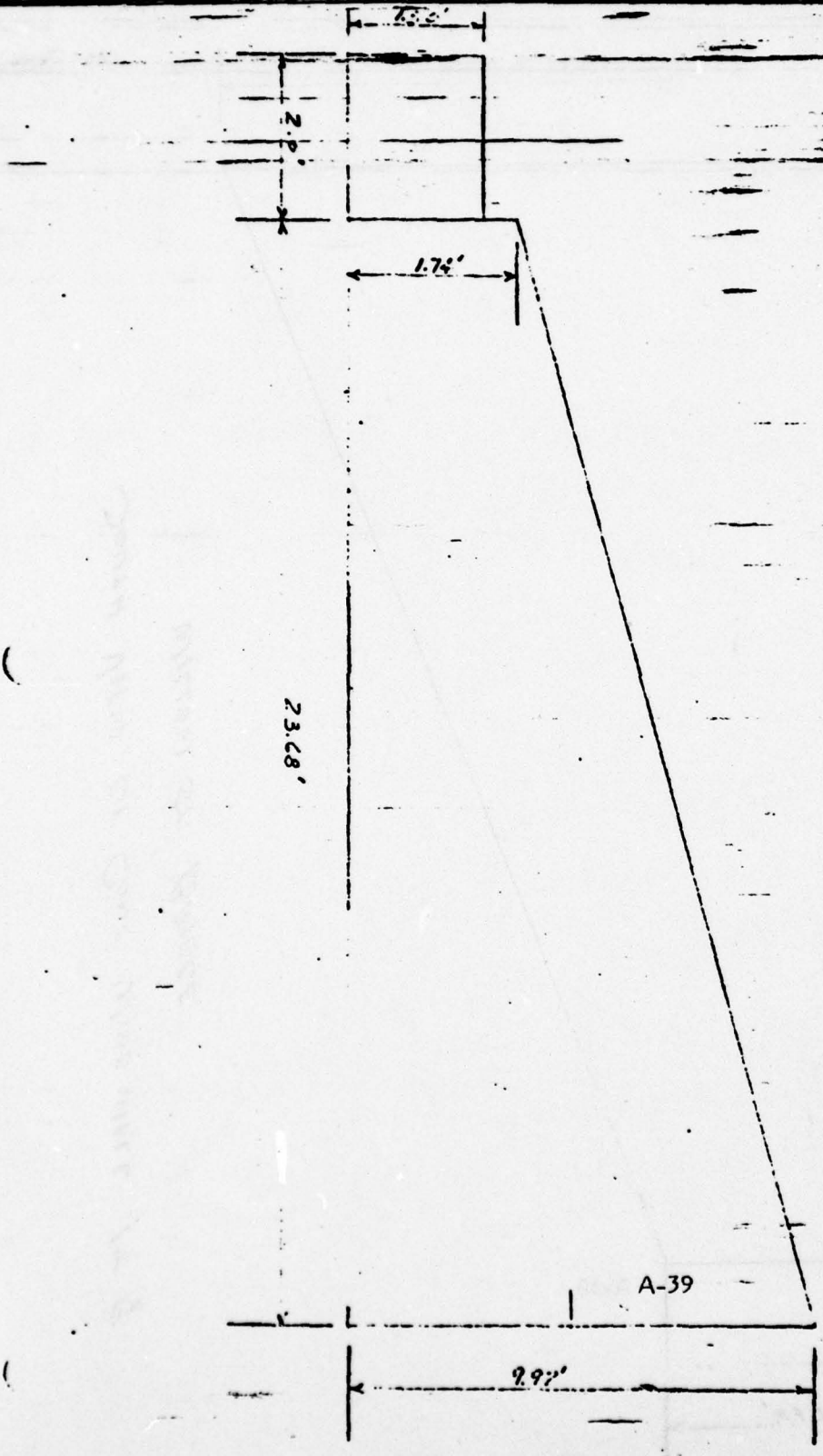
DELAWARE STATE HIGHWAY DEPARTMENT

Field Measurements And
Preliminary Calculation of Quantities

Source Document #

By:

Entered In:



NORTH VIEW OF CONC. WING WALL AT #2

WILLOW ST. BRIDGE

CN-11-2/68

Contract No.

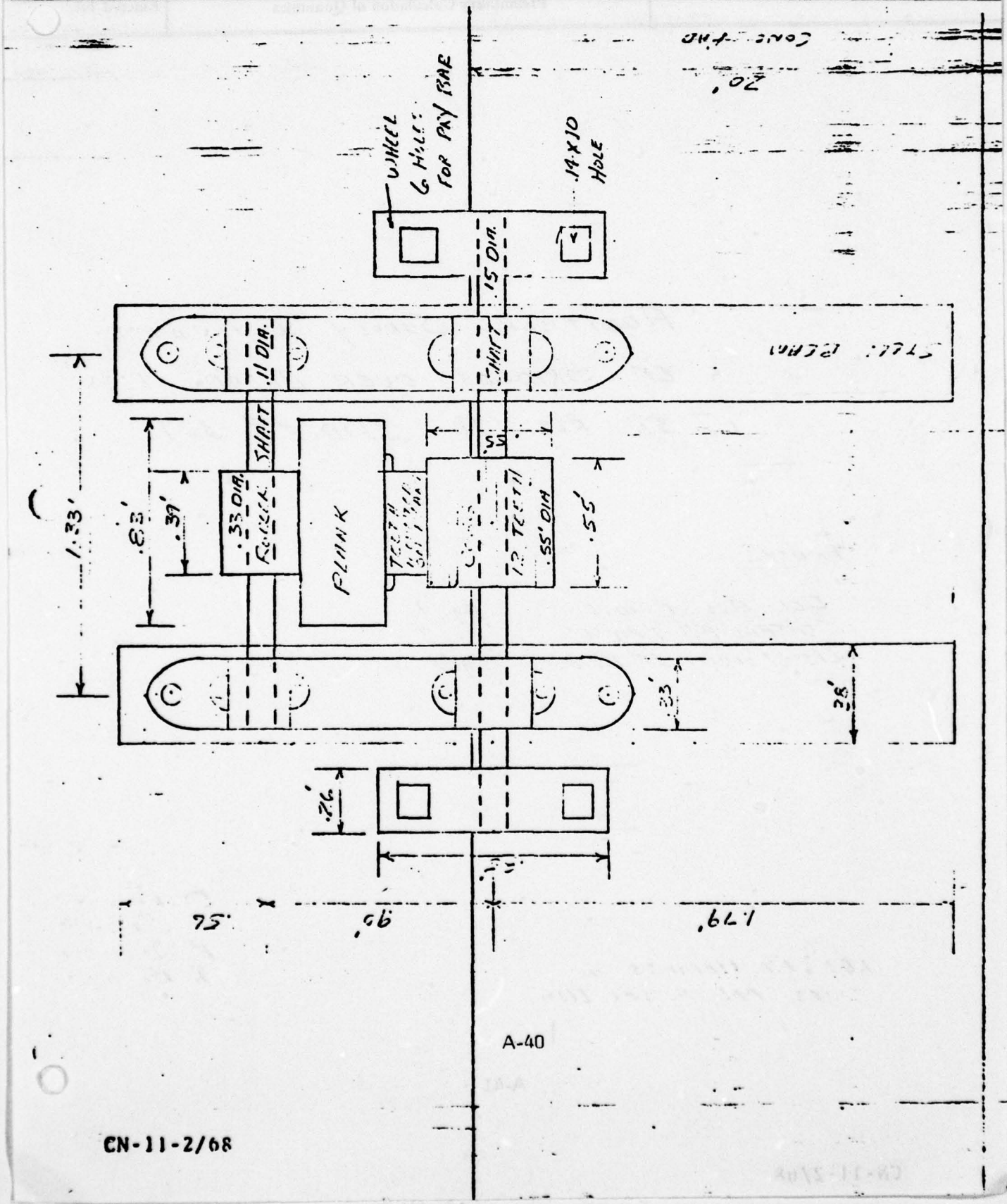
Item:

Field Measurements And
Preliminary Calculation of Quantities

Document #

By:

Entered In:



A-40

CN-11-2/68

Contract No.	DELAWARE STATE HIGHWAY DEPARTMENT	Source Document #
Item:	Field Measurements And Preliminary Calculation of Quantities	By:
		Entered In:

ADDITIONAL SURVEY INFORMATION
OF BRIDGES OVER BROAD CREEK
IN REF. TO BRIDGE # 329

INDEX:

DELAWARE STATE HIGHWAY DEPARTMENT

Field Measurements And
Preliminary Calculation of Quantities

Contract No.

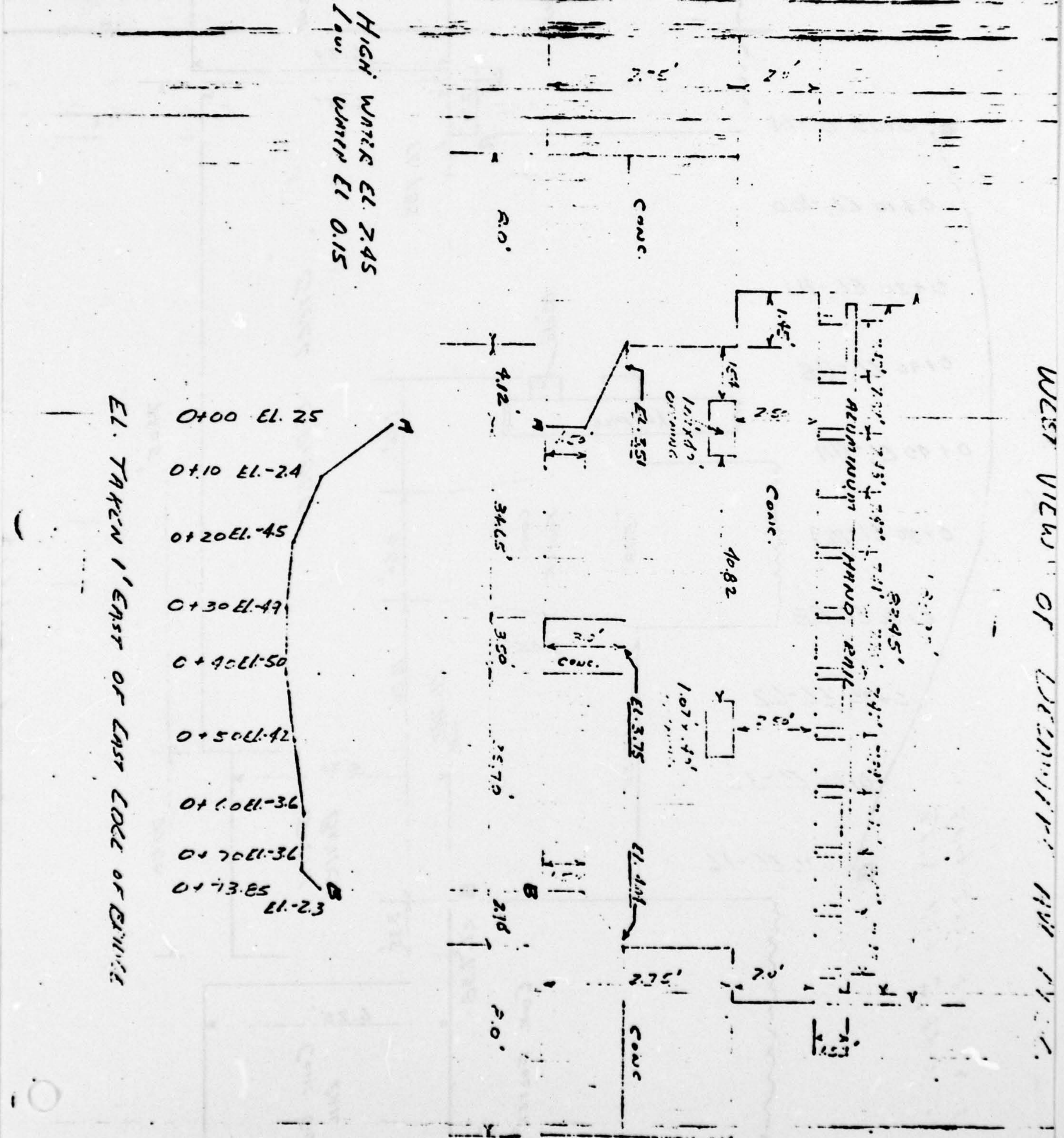
Item:

Source

Document #

By:

Entered In:



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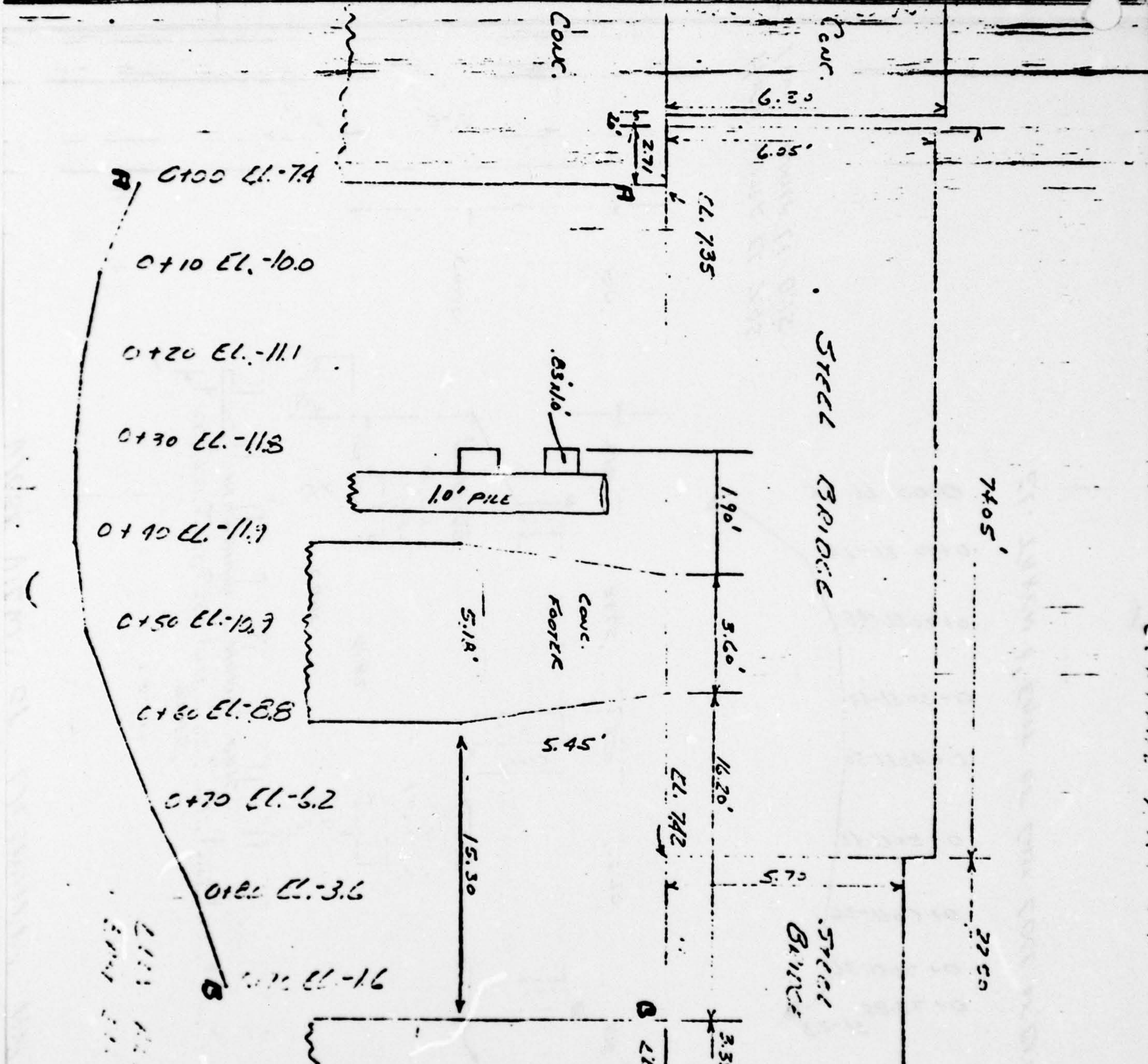

Contract No.	DELAWARE STATE HIGHWAY DEPARTMENT	Source Document #
Item:	Field Measurements And Preliminary Calculation of Quantities	By:
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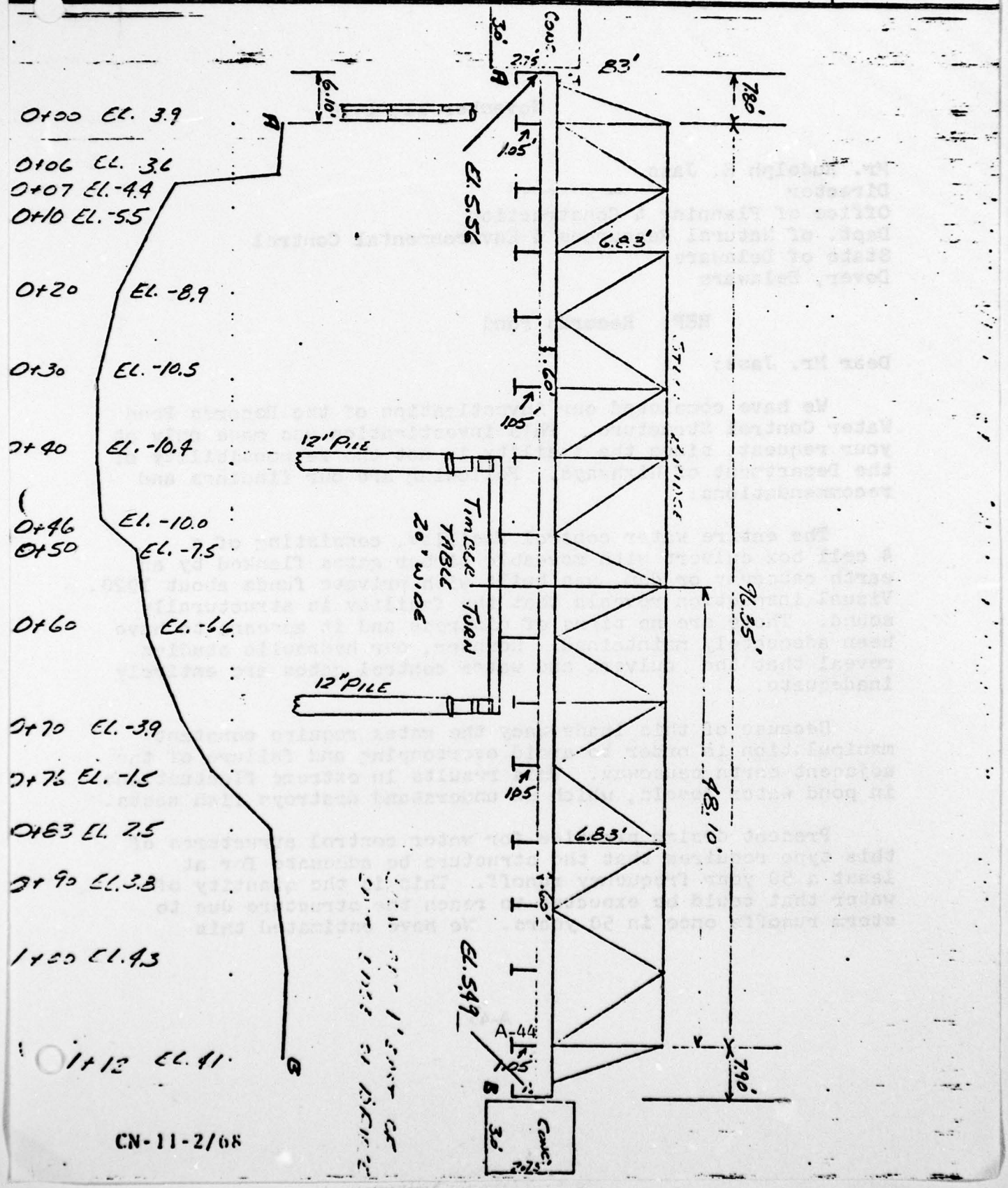


CN-11-2/68

November 11, 1970

Mr. Rudolph E. Jass
Director
Office of Planning & Construction
Dept. of Natural Resources & Environmental Control
State of Delaware
Dover, Delaware

REF: Records Pond

Dear Mr. Jass:

We have completed our investigation of the Records Pond Water Control Structure. This investigation was made only at your request, since the facility is not the responsibility of the Department of Highways. Following are our findings and recommendations:

The entire water control facility, consisting of a 4 cell box culvert with moveable timber gates flanked by an earth causeway or dam, was built with private funds about 1920. Visual inspection reveals that the facility is structurally sound. There are no signs of distress and it appears to have been adequately maintained. However, our hydraulic studies reveal that the culvert and water control gates are entirely inadequate.

Because of this inadequacy the gates require constant manipulation in order to avoid overtopping and failure of the adjacent earth causeway. This results in extreme fluctuations in pond water levels, which we understand destroys fish nests.

Present design practice for water control structures of this type requires that the structure be adequate for at least a 50 year frequency runoff. This is the quantity of water that could be expected to reach the structure due to storm runoffs once in 50 years. We have estimated this

quantity at 2,840 cubic feet per second.

Even with the gates completely open the existing structure is not capable of carrying this quantity of water. Thus the present practice of lowering the pond level in anticipation of heavy runoffs is necessary.

In order to correct this situation we would recommend construction of a new bridge and water control structure. In order to eliminate water control gate manipulation and maintenance, we recommend the use of a fixed weir type structure large enough to accommodate the design runoff of 2,840 c.f.s. The existing structure would remain in place with the gates maintained for draining the pond or other purposes as may be required. They would also be available for emergency use should runoffs greater than the design occur.

The attached sketch indicates this solution, utilizing a semi-circular weir similar to several constructed elsewhere in the State. We estimate the cost of this improvement would be $200,000.

Until such improvements are made it is imperative that constant maintenance of the present gates be continued. Without gate manipulation, causeway overtopping and failure would be a certainty.

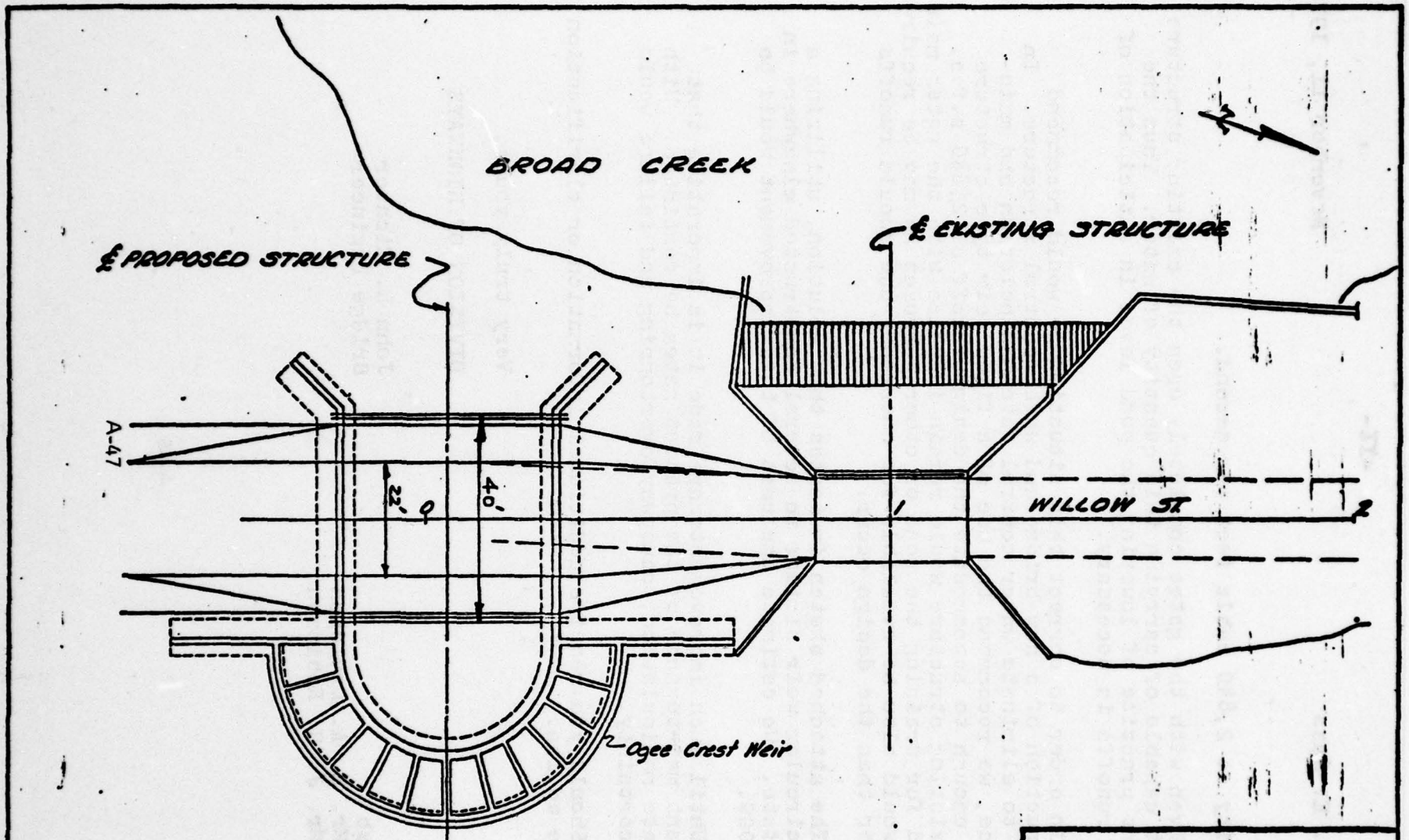
Should you require additional information or clarification please advise.

Very truly yours,

DIVISION OF HIGHWAYS

John E. Richter
Bridge Engineer

JER:ysb
cc: Mr. E. A. Davidson
Mr. J. S. Robinson



RECORDS POND INVESTIGATION

STATE OF DELAWARE
DEPT. OF HIGHWAYS AND TRANSPORTATION
DIVISION OF HIG WAYS

RECORDS POND - SUSSEX CO.

Records Pond Water Control structure.

Drainage Area = 46737 Acres = 73.1 sq. miles (approx.)
Design frequency = 50 years

46737 Acres
− 95 Acres (Records Pond area)
46642 Acres

Using Burkli-Ziegler Formula

$$Q = AC i \sqrt[4]{S/A}$$

$$\therefore Q = 46642 \times 0.20 \times 3.25 \sqrt[4]{\frac{2}{46642}}$$

$$= 2453 \text{ c.f.s.}$$
(considering no loss in Records Pond area) (Considering Partial loss in Chipmen Pond)

$\therefore$ Total Q = 2453 + 95 × 3.25 + 40 × 2.00
= 2841 c.f.s Say 2840 c.f.s.

using computer data of the Trap Pond outle

$$\frac{46642}{640} \times \frac{582}{16.7} = 2540 \text{ c.f.s.}$$

$\therefore$ total Q = 2540 + 95 × 3.25 + 40 × 2.00
= 2928 c.f.s.

Use 2840 c.f.s.

Existing Waterway area = 4 × 7.12 × 8.03 Sq. ft.
= 228.7 Sq. ft.

Existing top of opening EL. 9.16

We can have a max. upstream EL. 10.00, Beca beyond this El. going to endanger the property and houses along the pond.
$\therefore$ We have a max. Allowable Head (wat

From Computer Program Hydraulic Design of Culverts
for 2840 C.f.s. with A.H.W. 9.5' & D.T.W.
we need minimum waterway area = 4x11x8'
= 352 Sq. ft

With AHW = 9.8 & D.T.W. 3.0'
for 2840 C.f.s.
We need minimum Waterway area = 4x9'x8' Sq
= 288 Sq. ft

The opening we needed without considering t
tide which going to effect hydraulic and G all
lead water also.

Having a limit on allowable Head w
9 feet for 8.9 A.H.W., 2840 C.f.s. need a
at least 410 Sq. ft. minimum Waterway area
opening at Records Pond.

I also feel that it is better to ke
the existing water level of the Records
on the upstream side of the Br. #329., And
keep Between El. 7.5 and El. 8.00. So we have
immediate extra capacity for the flood
discharge. And so we would not have to al
the peak discharge from the structure and
to endanger the down stream of the Reco
Pond and Laurel town.

IWS 66-09-702 Oct. 26,

Records Pond Water Control structures

Drainage area = 46737 Acres
= 73.1 Sq. miles
Design frequency = 50 Years
Estimated runoff = 2840 cusecs

Hydraulics Capacity of the existing structure w opening the gate as a weir is 485 cusecs if allowable headwater is 2.9 feet above the top of existing gate elevation that means 8.6 + 2 = 11.50 H.W.L., which is the Road elevation If raise the H.W.L. to 12.6 the Hydraulics Cap. of the existing structure as a weir is 787 cu and if raise the H.W.L to 13.6 the Hydraulics cap of the existing structure as a weir is 1100 cusa From the above one can conclude that existing structure as a weir is inadequate for the estimated runoff.

The existing structure with opening of all gates is barely adequate to carry estimated runoff with very high pon on the upstream side and without high tide on downstream side and also w the loss of fish, water fowl nests, and all o forms of ecology which line in the upper p of the pond water.

A-50

cont'd. 66-09-702 Oct. 2

In accordance with the telephone conversation with Mr. dept. of natural resources environmental control would like to have Water control structure with some fixed e and without the operations of gates.

If we choose fixed elevation spillway need to have another spillway to carry 2355 cfs.

For this runoff we need 125' spil

Because of the obviously long length spillway that would be required if upstre conditions were to be unchanged, it was de to consider only the ogee shape since the most efficient of all types.

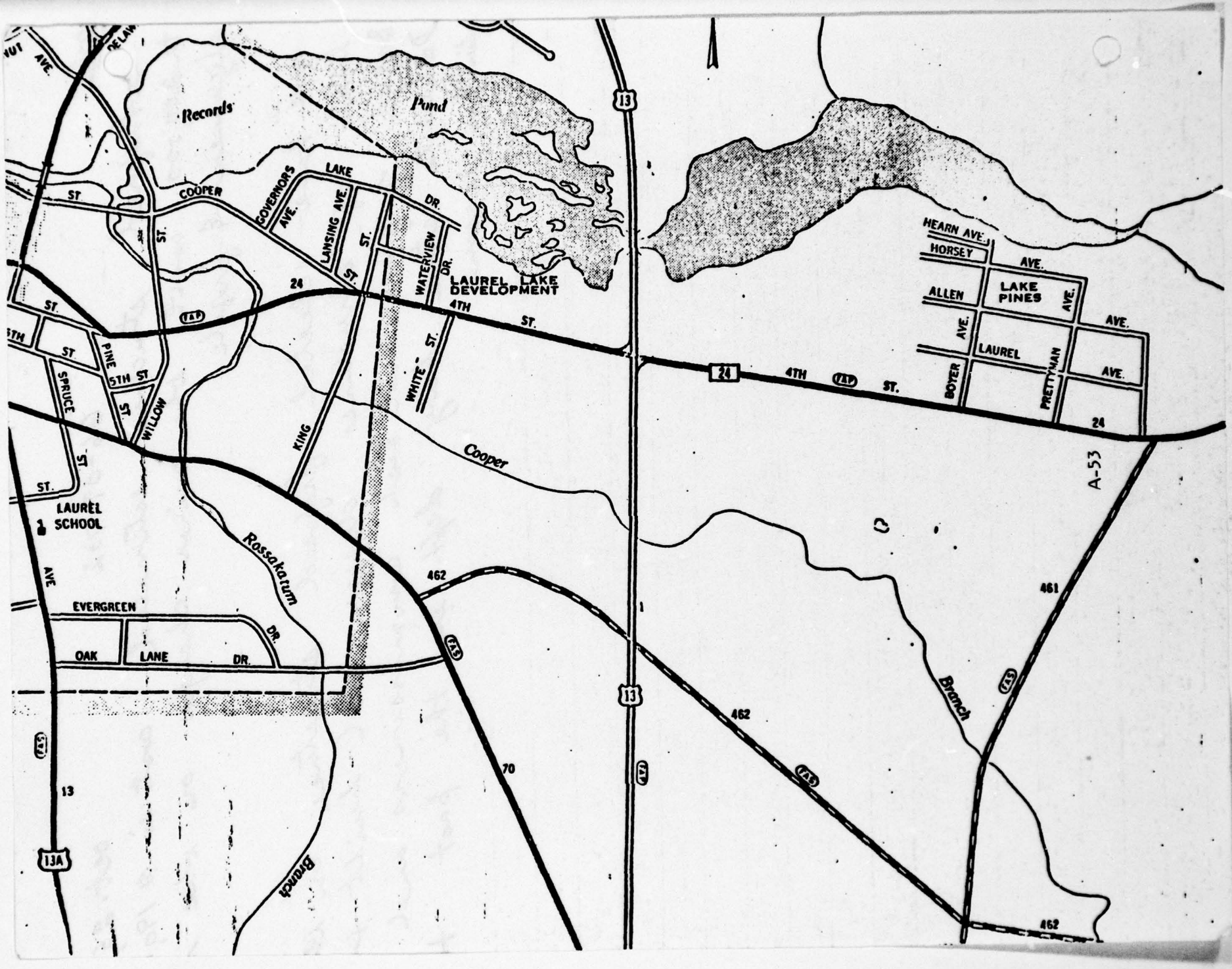
As previously discussed, using the crite of not raising the water level on upstrea side, it was necessary to provide for a 125 long spillway. This could not be done wi a straight spillway since it was not possi to reduce the width.

In addition, any shape other than the o increased the length of spillway required Fo this reason, a curved ogee spillway was sel

ZL 66-09-702 Oct. 26,

Proposed structure estimated cost is $ 190,
to 200,000 with the minor changes on the
alignment & profile.

we have selected proposed structure on th
basis of structures design and built fo
Board of game and fish commissioners and
Delaware state hwy. dept. in the past fo
similar reason.


Records
Pond
LAKE
COOPER ST
GOVERNORS AVE.
LANSING AVE.
ST.
DR.
WATERVIEW DR.
LAUREL LAKE DEVELOPMENT
4TH ST.
24
WHITE ST.
PINE ST.
5TH ST.
SPRUCE ST.
WILLOW ST.
KING ST.
Cooper
LAUREL SCHOOL
Rossakatum Branch
EVERGREEN DR.
OAK LANE DR.
462
70
13
13A
1
HEARN AVE.
HORSEY AVE.
ALLEN AVE.
LAKE PINES AVE.
LAUREL
BOYER AVE.
PRETTYMAN AVE.
461
Branch
A-53

2nd 66-09-702 Oct. 27,

Records Pond water control structures

Drainage area = 46737 Acres
= 73.1 Sq. miles

Design frequency = 50 years

Estimated runoff = 2841 cusecs

formula used to calculate estimated runoff as under

$$Q = ACi\sqrt[4]{S/A}$$

Where Q = Estimated runoff
A = Drainage area in A
C = Coefficient depending the character of the s drained
i = Average rate of rainfal inches per hour
S = Average of slope of gr in ft. per 1000 ft.

In our case A = 46737
− 95 (Records pond
46642

C = 0.20

i = 3.25

S = 2

$$Q = 46642 \times 0.20 \times 3.25 \sqrt[4]{2/46642}$$

= 2453 (considering full concentration in Records Pond

Q_{Total} = 2453 + 3.25 × 95 + 20 × 40

= 2453 + 308 + 80

= 2841 cusecs

oct. 27,

Hydraulics capacity of the existing structure without opening the gate as a spillway is cusecs, if allowable headwater is 2.9 feet ab the top of existing gate elevation that mean $8.60 + 2.90 = 11.50$ H.W.L., which is the Road profil elevation between structure.

If we allow to raise the H.W.L. to 12. the hydraulics capacity of the existing str as a spillway is 787 cusecs. And if u allow to raise the H.W.L. to 13.6 the hy capacity of the existing structure as a spill is 1100 cusecs.

The formula used to calculate abo discharge is as follows

$$Q = CLH^{3/2}$$

where

C = discharge coef
Inour case 3.

L = spillway leng

H = hydraulics he
above top of th
spillway

Q = Calculated run

$3.45 \times 28.5 \times 2.9^{1.5} \quad 485$

From the above one can conclude that existing structure as a spillway is ina eq for the estimated runoff.